SEAMAP-SA

RESULTS OF TRAWLING EFFORTS IN THE COASTAL HABITAT OF THE SOUTH ATLANTIC BIGHT, FY - 2001

Prepared By

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INTRODUCTION

The Southeast Area Monitoring and Assessment Program - South Atlantic (SEAMAP-SA) Shallow Water Trawl Survey, funded by the National Marine Fisheries Service (NMFS) and conducted by the South Carolina Department of Natural Resources - Marine Resources Division (SCDNR-MRD), began in 1986. This survey provides long-term, fishery-independent data on seasonal abundance and biomass of all finfish, elasmobranchs, decapod and stomatopod crustaceans, and cephalopods that are accessible by high-rise trawls. In addition to the twenty-three species of finfish and four decapod species previously selected as target species by the SEAMAP-SA Shallow Water Trawl Committee, all species of sharks, sea turtles, and horseshoe crabs were added to the list of priority species. Additional data recorded for target species include measurements of length or width for all priority species, sex and individual weights for sharks and horseshoe crabs, and reproductive information on commercially important penaeid shrimp and blue crabs.

Field data collected by the SEAMAP-SA Shallow Water Trawl Survey are available to users within a few weeks of collection. SEAMAP-SA trawl data collected from 1986 to the present are now available through the SEAMAP-SA Data Management Office at NMFS[1]. Management agencies and scientists currently have access to twelve years (1990-2001) of comparable trawl data from near-shore coastal areas of the South Atlantic Bight.

This report summarizes information on species composition, abundance, and biomass from SEAMAP-SA trawls. Length-frequency distributions of commercially and ecologically important priority species, along with reproductive attributes of the commercially important penaeid species, are presented.

[1]Data are available through the SEAMAP Data Manager (NMFS Mississippi Laboratory, P.O. Box 1207, Pascagoula, MS 39568-1207).

METHODS AND MATERIALS

Data Collection

Samples were taken by trawl from the coastal zone of the South Atlantic Bight (SAB) between Cape Hatteras, North Carolina, and Cape Canaveral, Florida (Figure 1). Multi-legged cruises were conducted in spring (mid-April - mid-May), summer (mid-July - early August), and fall (early October - mid-November).

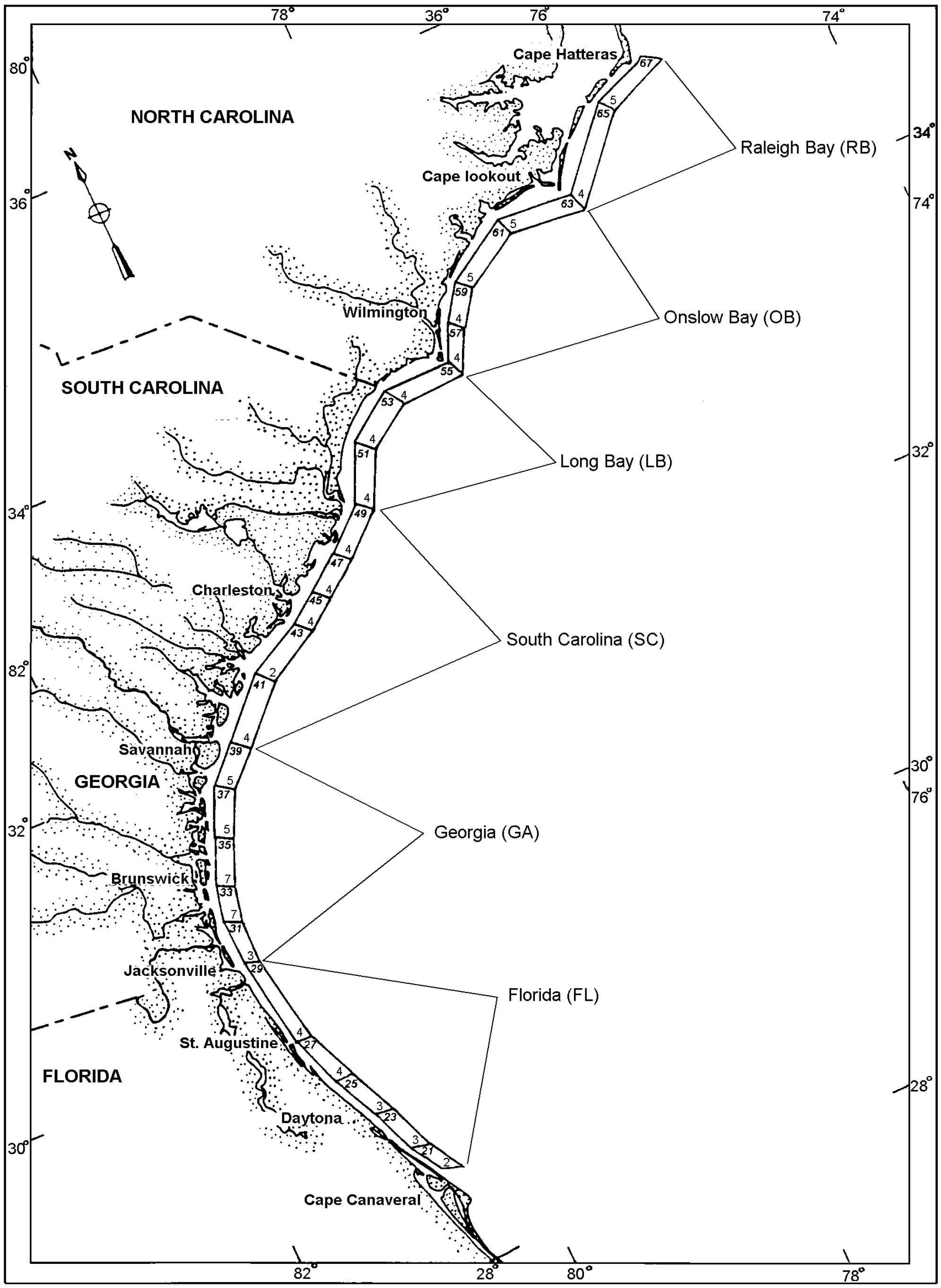

Figure 1. Strata sampled by the SEAMAP-SA Shallow Water Trawl Survey in 2001. Stratum number in indicated at the top of each rectangle and number of trawls towed is located in the lower portion of each stratum. (Strata are not drawn to scale.)

Stations were randomly selected from a pool of trawlable stations within each stratum. The number of stations sampled in each stratum was determined by optimal allocation. A total of 102 stations were sampled each season within twenty-four inner or shallow water strata (Table 1), representing an increase from 78 inner stations sampled historically by the survey. Strata were delineated by the 4 m depth contour inshore and the 10 m depth contour offshore. In previous years stations were sampled in deeper strata with station depths ranging from 10 to 19 m in order to gather data on the reproductive condition of commercial penaeid shrimp. Those strata were abandoned in order to intensify sampling in the more shallow depth-zone.

The R/V *Lady Lisa*, a 75-ft (23-m) wooden-hulled, double-rigged, St. Augustine shrimp trawler owned and operated by the South Carolina Department of Natural Resources (SCDNR), was used to tow paired 22.9-m mongoose-type Falcon trawl nets (manufactured by Beaufort Marine Supply; Beaufort, S.C.) without TED's. The body of the trawl was constructed of #15 twine with 1.875-in (47.6-mm) stretch mesh. The cod end of the net was constructed of #30 twine with 1.625-in (41.3-mm) stretch mesh and was protected by chafing gear of #84 twine with 4-in (10-cm) stretch "scallop" mesh. A 300 ft (91.4-m) three-lead bridle was attached to each of a pair of wooden chain doors which measured 10 ft x 40 in (3.0-m x 1.0-m), and to a tongue centered on the head-rope. The 86-ft (26.3-m) head-rope, excluding the tongue, had one large (60-cm) Norwegian float attached top center of the net between the end of the tongue and the tongue bridle cable and two 9-in (22.3-cm) PVC foam floats located one-quarter of the distance from each end of the net webbing. A 1-ft chain drop-back was used to attach the 89-ft foot-rope to the trawl door. A 0.25-in (0.6-cm) tickler chain, which was 3.0-ft (0.9-m) shorter than the combined length of the foot-rope and drop-back, was connected to the door alongside the foot-rope.

Trawls were towed for twenty minutes, excluding wire-out and haul-back time, exclusively during daylight hours (1 hour after sunrise to 1 hour before sunset). Contents of each net were sorted separately to species, and total biomass and number of individuals were recorded for all species of finfish, elasmobranchs, decapod and stomatopod crustaceans, cephalopods, sea turtles, xiphosurans, and cannonball jellies. Marine turtles captured incidentally were measured, weighed, tagged, and released according to NMFS permitting guidelines. Only total biomass was recorded for all other miscellaneous invertebrates (excluding cannonball jellies) and algae, which were treated as two separate taxonomic groups.

Where large numbers of indviduals of a species occurred in a collection, the entire catch was sorted and all individuals of that species were weighed, but only a randomly selected subsample was processed and total number was calculated. For trawl catches where visual estimation of weight of total catch per trawl exceeded 500 kg, the contents of each net were weighed prior to sorting and a randomly chosen subsample of the total catch was then sorted and processed.

In every collection, each of the target species was weighed collectively and individuals were measured to the nearest centimeter (Appendix 1). For large collections of the target species, a random subsample consisting of thirty to fifty individuals was weighed and measured. Depending on the species, measurements were recorded as total length, fork length, or carapace width.

Additional data was collected on individual specimens of penaeid shrimp (total length in mm, sex, female ovarian development, male spermatophore development, occurrence of mated females), blue crabs (carapace width in mm, individual weight, sex, presence and developmental stage of eggs), sharks (total and fork lengths in cm, individual weight, sex), horseshoe crabs (prosoma width and length in mm, individual weight, sex), and sea turtles (curved and straight lengths and widths in cm, individual weight, PIT and flipper tag numbers).

Gonad and otolith specimens were also collected during seasonal cruises. A representative sample of specimens were measured to the nearest mm (TL and SL), weighed to the nearest gram, and assigned a sex and maturity code (Wenner et al., 1986). Sagittal otoliths and a representative series of gonadal tissue were removed, preserved, and transported to the laboratory at MRRI, where samples were processed (Walton, 1996). Results of data collected from specimens of *Cynoscion regalis* and *Micropogonias undulatus* are presented in this report.

Hydrographic data collected at each station included surface and bottom temperature and salinity measurements taken with a Seabird SBE-19 CTD profiler, sampling depth, and an estimate of wave height. Additionally, atmospheric data on air temperature, barometric pressure, precipitation, and wind speed and direction were also noted at each station.

Data Analysis

The SAB was separated into six regions for data analysis (Figure 1). Raleigh Bay (RB), Onslow Bay (OB) and Long Bay (LB) were each considered to be regions. South Carolina, excluding Long Bay (SC), Georgia (GA), and northern Florida (FL) were also treated as separate regions.

Data from the paired trawls were pooled for analysis to form a standard unit of effort (tow). In an effort to reduce the variability of the data, the method of allocating the number of stations within each stratum was changed from proportional allocation to optimal allocation (Thompson, 1992). The coefficient of variation (CV), expressed as a proportion, was used to compare relative amounts of variation in abundance among years and among species (Sokal and Rohlf, 1981). Density estimates, expressed as number of individuals or kilograms per hectare (ha), were standardized by dividing the mean catch per tow by the mean area (ha) swept by the combined trawls. Mean area swept by a net was calculated by multiplying the width of the net opening (13.5 m) as determined by Stender and Barans (1994) by the distance (m) trawled and dividing the product by 10000 m^2/ha.

Results for priority species are presented and discussed individually in this report. Statistically significant differences in lengths of individuals among seasons and regions were determined using the non-parametric Kruskal-Wallis test (Sokal and Rohlf, 1981). Size differences among shark genders were determined to be statistically different with the non-parametric Wilcoxon test. Contingency tables using the G-statistic were used to determine if occurrence of ripe penaeid shrimp were independent of season and region.

RESULTS AND DISCUSSION

Hydrographic Measurements

Hydrographic patterns of temperature and salinity in the SAB are driven by four major influences which fluctuate seasonally: river run-off, the Gulf Stream, a southerly flowing coastal current, and atmospheric conditions. The warm, highly saline waters of the Gulf Stream, in close proximity to coastal waters off Florida and in Raleigh Bay, elevate temperatures and salinities in those areas (Pietrafesa et al., 1985). Most of the river run-off in the SAB occurs south of Cape Fear (Blanton and Atkinson, 1983; McClain et al., 1988). Water of lower salinity created by freshwater influx is pushed southward by the southerly flowing coastal current; however, this movement is impeded by the northerly flowing Gulf Stream off northern Florida (Blanton, 1981; Blanton and Atkinson, 1983). The result of this process is a concentration of lower salinity water off southern South Carolina and Georgia. Seasonal fluctuations in river run-off, atmospheric conditions, and migrations of the Gulf Stream dictate the magnitudes of these hydrographic patterns.

Typical seasonal and regional patterns of temperature and salinity were observed during the 2001 survey (Table 1). The annual and seasonal mean temperatures were slightly lower and mean salinities were slightly higher than the estimates calculated for 1990-1999 (SEAMAP-SA/SCMRD, 2000).

Table 1. Seasonal mean bottom temperatures (°C) and salinities (‰) from each region for 2001. Regions are abbreviated as follows: Raleigh Bay (RB), Onslow Bay (OB), Long Bay (LB), South Carolina (SC), Georgia (GA), and Florida (FL).

	RB	OB	LB	SC	GA	FL	ALL REGIONS
SPRING							
$\bar{x}$ Temperature	16.7	18.3	20.4	18.9	19.4	20.9	19.3
$\bar{x}$ Salinity	34.3	35.7	35.1	35.0	34.0	36.1	35.0
SUMMER							
$\bar{x}$ Temperature	24.8	26.8	27.5	27.8	28.3	24.9	26.9
$\bar{x}$ Salinity	33.3	35.6	35.1	35.1	35.0	36.4	35.2
FALL							
$\bar{x}$ Temperature	22.4	21.8	21.3	20.4	18.8	23.6	21.1
$\bar{x}$ Salinity	34.1	36.0	35.6	35.5	35.3	34.6	35.3
ALL SEASONS							
$\bar{x}$ Temperature	21.3	22.3	23.1	21.4	22.2	23.1	22.3
$\bar{x}$ Salinity	33.9	35.7	35.3	35.2	34.7	35.7	35.2

Species Composition

The 2001 sampling effort resulted in the collection of 178 species (Appendix 2). Trawls produced 110 species of finfish, 26 species of elasmobranchs, 33 species of decapod crustaceans, 2 species of stomatopod crustaceans, and 3 genera of cephalopods.

The number of species collected varied seasonally (Table 2), with greatest diversity from trawls towed in fall. Summer, the season of peak abundance, produced the smallest number of species. Regionally, the greatest number of species was found in Long Bay, with the number of species decreasing north and southward.

Table 2. Summary of effort (number of trawl tows), diversity (number of species), abundance (number of individuals), biomass (kg), density of individuals (number/ha), and density of biomass (kg/ha), excluding miscellaneous invertebrates and algae, by region and season.

	Effort (Tows)	Diversity (Species)	Abundance Individuals	Abundance Biomass	Density Individuals	Density Biomass
Region						
RALEIGH BAY	27	101	68319	4892.9	656.9	47.0
ONSLOW BAY	54	118	109164	6061.5	521.3	28.9
LONG BAY	36	120	33875	3424.8	248.5	25.1
S. CAROLINA	54	116	39770	2283.2	195.2	11.2
GEORGIA	81	115	83215	3426.0	281.6	11.6
FLORIDA	54	101	102928	5781.9	475.7	26.7
Season						
SPRING	102	129	108836	10132.9	270.0	25.1
SUMMER	102	123	206201	10695.3	517.7	26.9
FALL	102	143	122234	5042.1	321.3	13.3

Abundance, Biomass, and Density Estimates

The 2001 SEAMAP- South Atlantic Shallow Water Trawl Survey caught 437,340 individuals (CV=3.1; 1429 individuals/tow), with a biomass of 27,071 kg (88.5 kg/tow). Miscellaneous invertebrates and algae contributed an additional 35,362 kg of biomass (including cannonball jellies). The overall density of individuals (440 individuals/ha) in 2001 (excluding cannonball jellies) was the highest estimate observed since 1991 (Figure 2). This peak in abundance was accompanied by a decrease in variability.

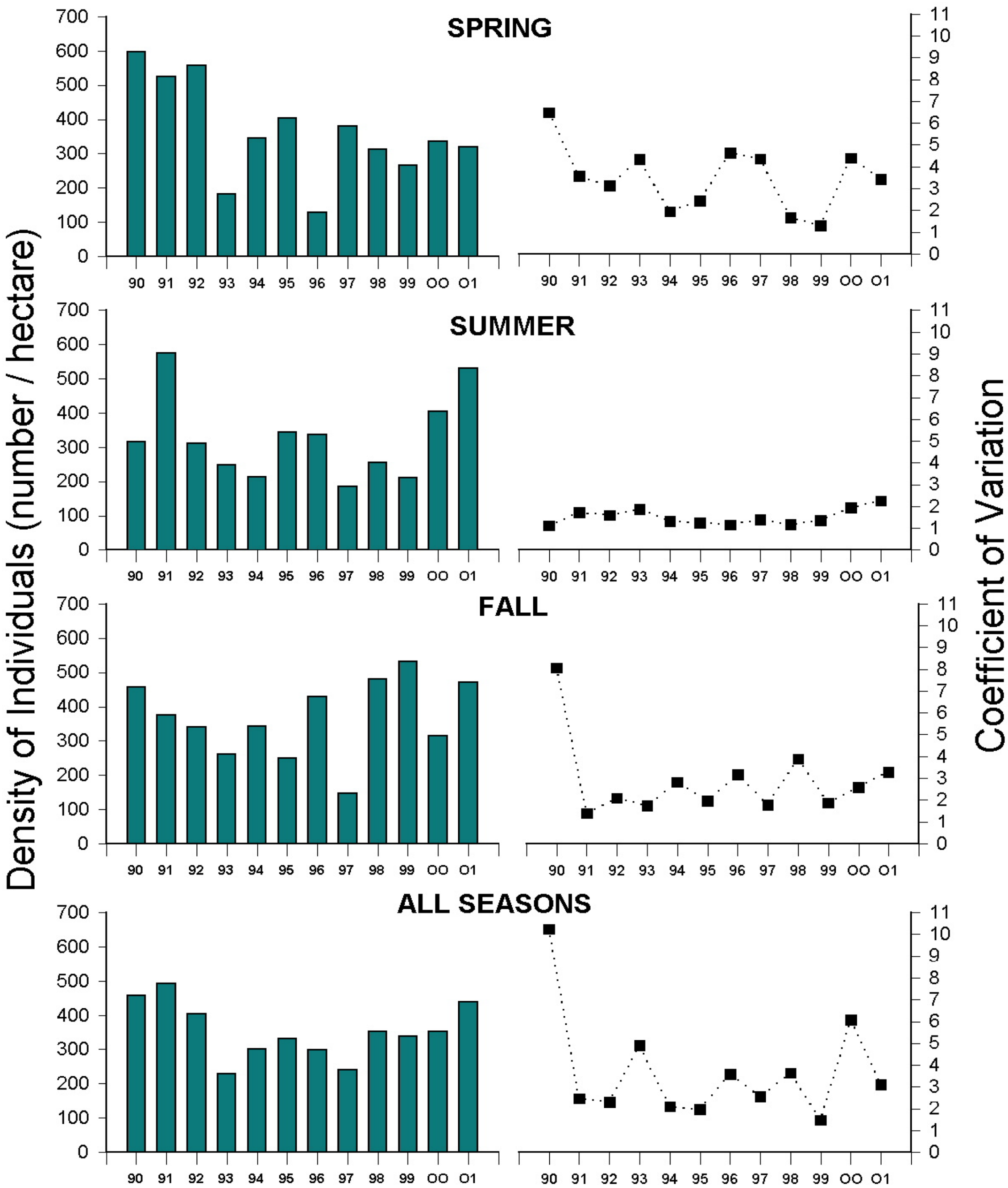

Figure 2. Annual and seasonal densities of abundance from inner strata.

Densities of individuals were highest in summer in 2001 (Figure 2). The summer density estimates were the second highest in the history of the survey. Densities of biomass also peaked in summer collections (Table 2). The highest regional density of individuals and biomass occurred in Raleigh and Onslow Bays, reflecting relatively large catches of sciaenids. The third highest density of abundance occurred in waters off Florida. Long Bay and South Carolina had the lowest densities of individuals.

Historically, patterns of abundance in the SAB generally reflect the abundance of two members of the sciaenid family, the spot, *Leiostomus xanthurus*, and the Atlantic croaker, *Micropogonias undulatus,* which have been consistent in their numerical dominance among years. These two species constituted approximately 29% of the total catch during the 2001 survey. However, in 2001, abundance and biomass of the cannonball jelly, *Stomolophus meleagris*, was recorded for the first time. The cannonball jelly ranked first in both abundance and biomass (Table 3), and made up 16% of the total catch and 39% of the biomass. The Atlantic croaker, *Micropogonias undulatus* was the second most abundant species, followed by the spot, *Leiostomus xanthurus*, and *Stenotomus* sp. The white shrimp, *Litopenaeus setiferus,* ranked tenth overall and was the second most abundant decapod crustacean collected, after *Libinia dubia*. After the cannonball jelly, the Atlantic croaker, *Micropogonias undulatus,* ranked second in biomass, followed by the cownose ray, *Rhinoptera bonasus*, and spot, *Leiostomus xanthurus* (Table 3).

Table 3. Regional and seasonal estimates of density of abundance (individuals/ha) and biomass (kg/ha), excluding miscellaneous invertebrates and algae, for dominant species in 2001.

	All	**Region**						**Season**		
	Strata	**RB**	**OB**	**LB**	**SC**	**GA**	**FL**	**SPR**	**SUM**	**FAL**
Abundance										
Stomolophus meleagris	69.7	0.2	0.5	6.7	113.0	173.0	33.3	50.1	12.9	150.1
Micropogonias undulatus	61.2	33.0	102.3	50.8	19.1	39.3	115.4	18.0	151.9	11.8
Leiostomus xanthurus	46.0	84.9	56.2	62.7	30.3	38.7	35.7	34.4	98.8	6.1
Stenotomus sp.	38.9	297.9	59.9	15.9	1.1	0.1	0.01	8.0	55.9	53.8
Peprilus triacanthus	34.8	111.5	101.9	6.1	18.2	8.0	6.0	94.0	7.8	0.3
Chloroscombrus chrysurus	25.1	0.06	2.6	12.3	9.7	8.4	106.3	4.6	20.8	51.3
Cynoscion nothus	13.5	0.02	2.0	2.7	1.1	3.3	64.4	2.5	32.6	5.1
Biomass										
Stomolophus meleagris	20.8	0.03	0.4	4.9	52.3	40.8	5.0	31.6	2.7	28.3
Micropogonias undulatus	2.9	2.2	6.5	1.8	0.7	1.5	4.7	1.1	6.9	0.7
Rhinoptera bonasus	2.4	5.2	2.0	3.2	3.6	1.3	1.3	4.8	0.03	2.2
Leiostomus xanthurus	2.1	3.1	2.4	3.3	1.0	1.7	2.3	1.8	4.0	0.4
Myliobatis freminvillei	1.4	0.4	1.3	8.6	1.0	0.03	0.04	4.0	0.02	0.2
Cynoscion nothus	1.4	0.002	0.09	0.2	0.07	0.2	6.9	0.2	3.8	0.1
Stenotomus sp.	1.3	7.5	3.1	0.4	0.03	0.002	0.001	0.3	1.7	1.8

Distribution and Abundance of Priority Finfish Species

Archosargus probatocephalus

Sheepshead range along the western Atlantic, Gulf of Mexico, and Central American coasts from Nova Scotia to Bahia de Sepetiba, Brazil (Randall, 1978). This species can be found in the brackish waters of estuaries as well as on reefs offshore.

The sheepshead, *Archosargus probatocephalus*, exhibited the lowest abundance observed in the history of the SEAMAP-SA survey in 2001. Only 11 sheepshead (CV=6.1; 0.009 individuals/ha) weighing 33.4 kg were taken. Catches of sheepshead peaked in 1992 and dropped to the lowest level in 2001 (Figure 3). Sheepshead were taken only in spring and fall in Onslow Bay in 2001 (Table 4). Lengths ranged from 40-89 cm ($\bar{x}$ = 49.0), with larger individuals taken in spring.

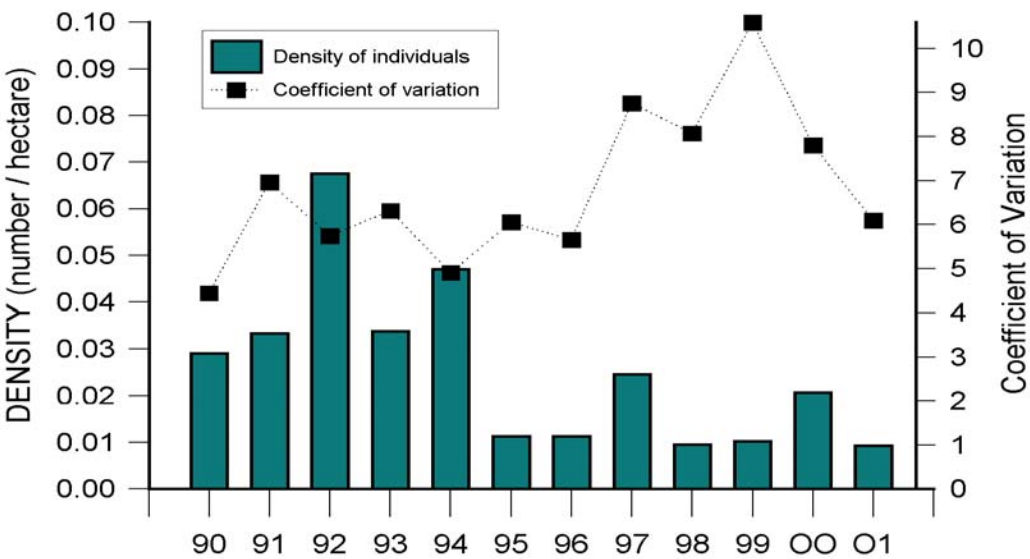

Figure 3. Annual densities of *Archosargus probatocephalus*.

Table 4 . Estimates of density (number of individuals/hectare) in 2001.

Archosargus probatocephalus

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0	0
Onslow Bay	0.06	0	0.1	0.05
Long Bay	0	0	0	0
South Carolina	0	0	0	0
Georgia	0	0	0	0
Florida	0	0	0	0
Season	0.01	0	0.02	0.009

Brevoortia smithi

The yellowfin menhaden is found along the Atlantic coast of the United States from Beaufort, N. Carolina to Indian River, Florida and on the Gulf of Mexico coast from Florida Bay to Louisiana (Whitehead, 1978). *B. smithi* is a pelagic inshore species present in bays and estuaries.

A total of only 4 yellowfin menhaden (CV=8.7; 0.0003 individuals/ha) weighing 1 kg were collected by the SEAMAP-SA Shallow Water Trawl Survey in 2001. Although density of individuals for this species peaked in 1991 (Figure 4), low abundance has been observed in subsequent years. In 2001, all yellowfin menhaden were caught in spring in waters off Florida (Table 5). Fork lengths of *Brevoortia smithi* ranged from 21 to 27 cm ($\bar{x}$ = 24.5).

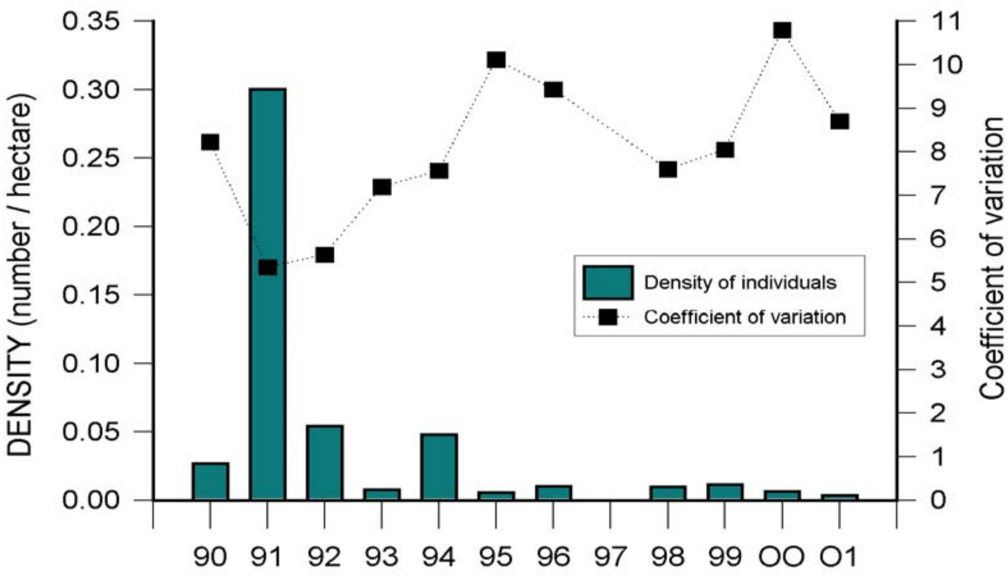

Figure 4. Annual densities of *Brevoortia smithi*.

Table 5 . Estimates of density (number of individuals/hectare) in 2001.

Brevoortia smithi

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0	0
Onslow Bay	0	0	0	0
Long Bay	0	0	0	0
South Carolina	0	0	0	0
Georgia	0	0	0	0
Florida	0.05	0	0	0.02
Season	0.01	0	0	0.003

Brevoortia tyrannus

The Atlantic menhaden occurs from Nova Scotia to Jupiter Inlet, Florida (Whitehead, 1978). *Brevoortia tyrannus* occurs in large, dense schools which are targeted by the purse-seine fishery off North Carolina (Smith, 1999).

A total of 1,023 Atlantic menhaden (CV=12.8; 0.9 individuals/ha) weighing 49 kg (0.04 kg/ha) were taken in SEAMAP-SA trawls. Density of individuals was at the highest level in the history of the survey in 1990 (Figure 5), with much lower abundance observed during the last eleven years. In 2001, density was greatest in spring and in waters off Georgia (Table 6).

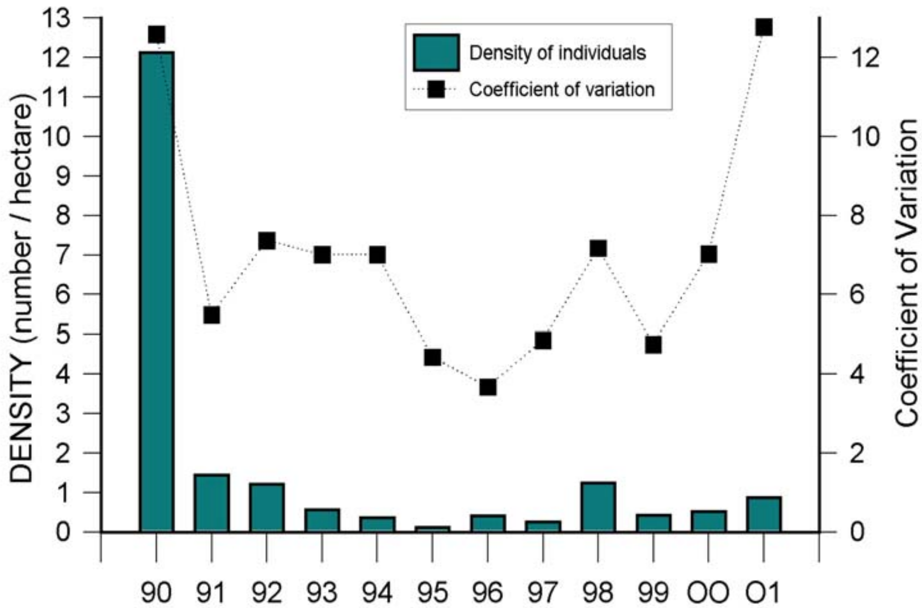

Figure 5. Annual densities of *Brevoortia tyrannus*.

Table 6 . Estimates of density (number of individuals/hectare) in 2001.

Brevoortia tyrannus

	Spring	Summer	Fall	Region
Raleigh Bay	0.03	0.03	0	0.02
Onslow Bay	0.4	0.07	0.1	0.2
Long Bay	0.2	0.5	0.09	0.3
South Carolina	0	0	0.5	0.2
Georgia	7.3	0.1	0.5	2.8
Florida	0.7	0.01	0.6	0.4
Season	2.1	0.1	0.3	0.9

Fork lengths of *Brevoortia tyrannus* ranged from 8 to 27 cm ($\bar{x}$ = 14.3). Length was significantly different among seasons (X^2 = 333, $p < 0.0001$). Mean length increased from spring to fall, an indication of juvenile growth (Figure 6). Length also varied significantly among regions (X^2 = 67, $p < 0.0001$). The mean length of Atlantic menhaden was greatest in collections from waters off South Carolina and smallest in Onslow Bay (Figure 7). The length-frequency distributions of Atlantic menhaden in the SAB were numerically dominated by individuals taken in spring when few large specimens were taken.

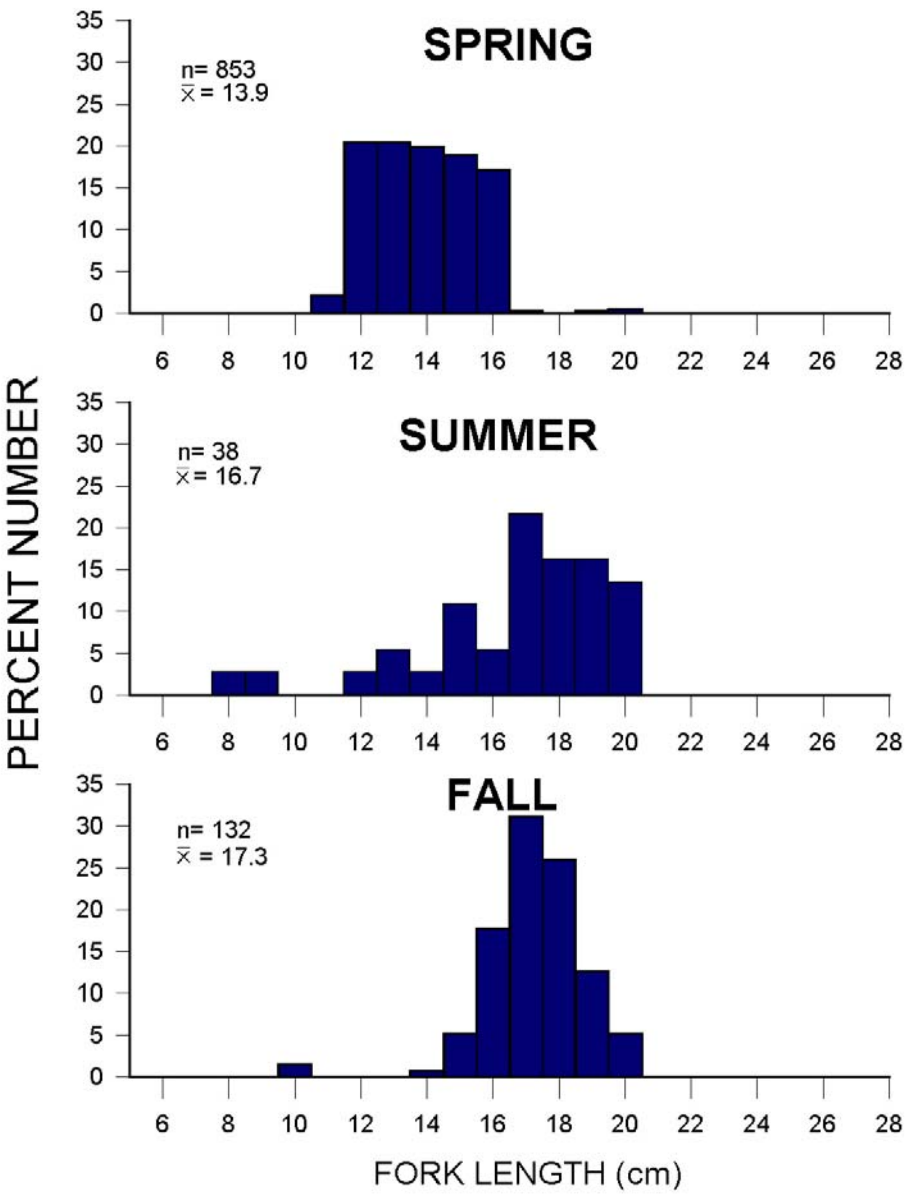

Figure 6. Seasonal length-frequencies of *Brevoortia tyrannus* in 2001.

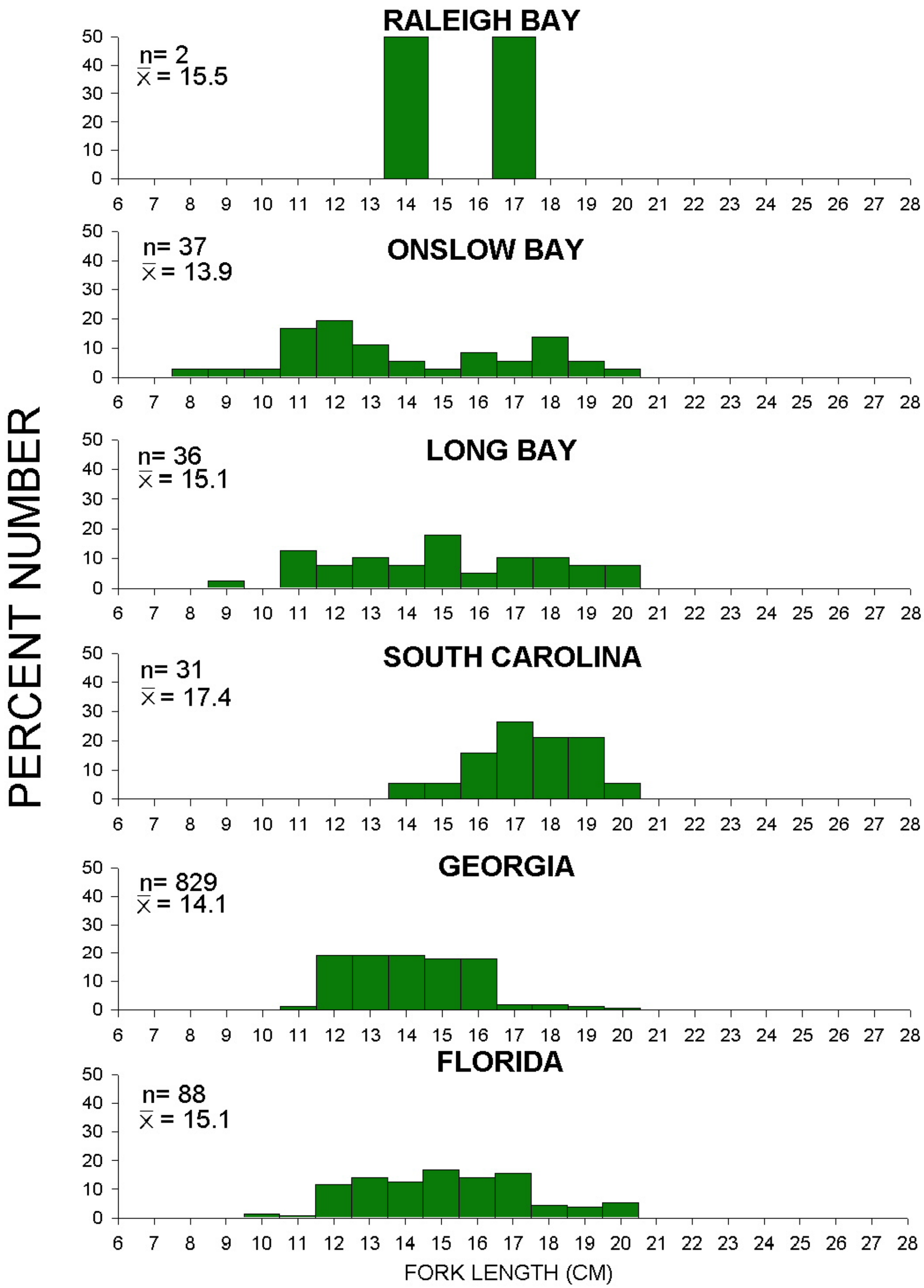

Figure 7. Regional length-frequencies of *Brevoortia tyrannus* in 2001.

Centropristis striata

Black sea bass occur on the western Atlantic coast from Massachusetts to Florida and in the Gulf of Mexico along the Florida coast from Placida to Pensacola (Smith, 1978). This species occurs around rocky and hard bottom, jetties, ledges, and pilings in shallow water (Robins and Ray, 1986). It is dispersed over a wide area on the continental shelf.

A total of 66 black sea bass (CV=4.9; 0.06 individuals/ha) weighing 4 kg (0.003 kg/ha) were collected in 2001. Density of individuals was at the lowest level in the history of the survey in 2001 (Figure 8). Density was greatest in spring collections in Onslow Bay (Table 7). Total lengths of *Centropristis striata* ranged from 10 to 31 cm ($\bar{x}$ = 15.5).

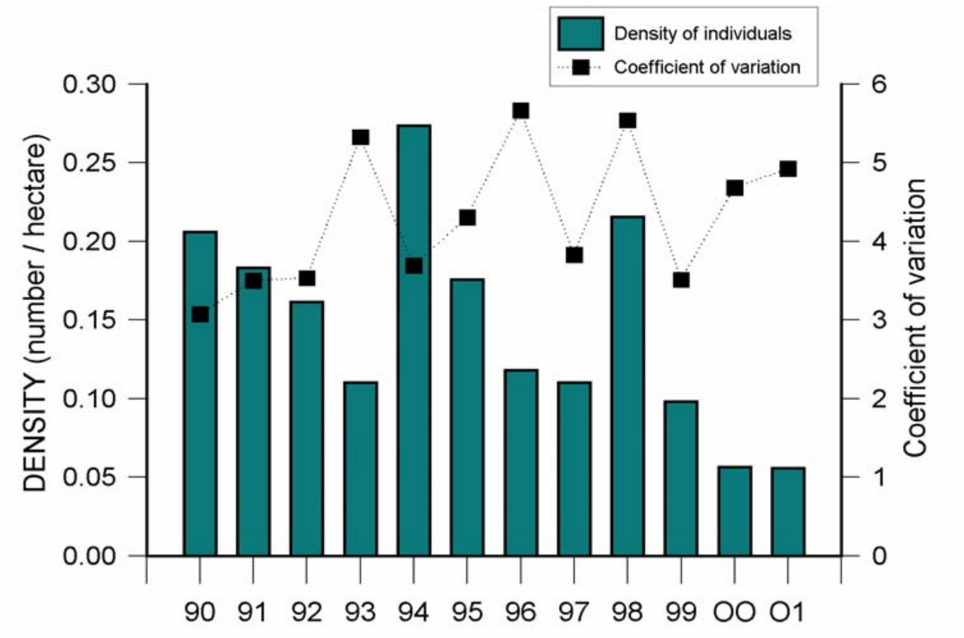

Figure 8. Annual densities of *Centropristis striata*.

Table 7 . Estimates of density (number of individuals/hectare) in 2001.

Centropristis striata

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0.04	0.01
Onslow Bay	0.07	0.5	0.1	0.2
Long Bay	0.1	0.07	0.1	0.1
South Carolina	0	0.02	0	0.005
Georgia	0	0	0	0
Florida	0	0	0	0
Season	0.02	0.1	0.04	0.06

Chaetodipterus faber

The Atlantic spadefish inhabits coastal waters from Chesapeake Bay to Brazil, throughout the Gulf of Mexico, and has been introduced into Bermuda (Burgess, 1978). Adults tend to congregate in schools around wrecks, pilings, rocky or reef areas. Spadefish are a common fish in South Carolina, particularly from early spring to late fall (Hayse, 1987).

SEAMAP strata yielded a total of 273 Atlantic spadefish (CV=3.5; 0.2 individuals/ha) weighing 12.5 kg (0.01 kg/ha). Density of individuals peaked in 1991, with a general decline in abundance in subsequent years to the lowest level of abundance observed in 2001 (Figure 9). Density was greatest in fall (Table 8). Atlantic spadefish were most abundant in waters off Georgia and Florida. Total lengths of *Chaetodipterus faber* ranged from 5 to 24 cm ($\bar{x}$ = 9.7).

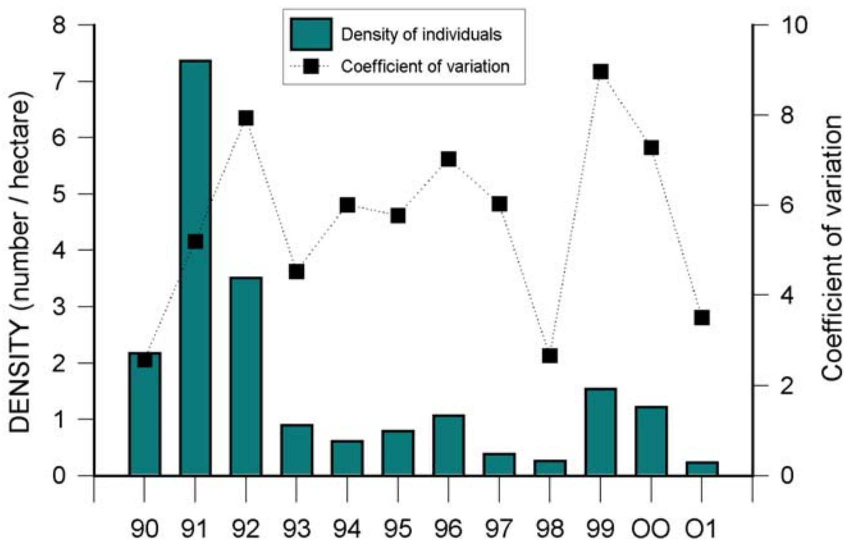

Figure 9. Annual densities of *Chaetodipterus faber*.

Table 8. Estimates of density (number of individuals/hectare) in 2001.

Chaetodipterus faber

	Spring	Summer	Fall	Region
Raleigh Bay	0.03	0	0.8	0.2
Onslow Bay	0.07	0.07	0.04	0.06
Long Bay	0.02	0.09	0.1	0.08
South Carolina	0	0.03	0.06	0.03
Georgia	0.2	0.5	0.6	0.4
Florida	0.2	0	1.1	0.4
Season	0.1	0.1	0.5	0.2

Cynoscion nebulosus

The spotted seatrout inhabits the western Atlantic coast from New York to South Florida and the Gulf of Mexico coast from South Florida to Laguna Madre, Mexico (Chao, 1978). This species is found over sand bottoms in shallow coastal waters and river estuaries as well as near seagrass beds and salt marshes in these habitats.

The spotted seatrout, *Cynoscion nebulosus*, has been a rare species in SEAMAP-SA collections. In the history of the SEAMAP survey only nine specimens have been collected, all in shallow strata. No spotted seatrout were collected in 2001.

Cynoscion regalis

Weakfish occur along the Atlantic coast of the United States from Nova Scotia to southern Florida and occasionally to the Gulf coast of Florida (Chao, 1978). Weakfish in the SAB are reported to move south from waters off North Carolina to Florida during fall migrations (Mercer, 1985). The weakfish is an important commercial and recreational species, primarily caught by hook-and-line, gill-nets, and bottom trawls (Bigelow and Schroeder, 1953; Thomas, 1971; Chao, 1978; Mercer, 1985).

In 2001, SEAMAP strata yielded a total of 7,366 weakfish (CV=4.3; 6.2 individuals/ha) weighing 401 kg (0.3 kg/ha). The density of abundance in 2001 represented an increase over the estimates from the previous two years; however, it was well below the peak observed in 1998 (Figure 10). In 2001, density was greatest in spring and decreased in subsequent seasons (Table 9). Weakfish were most abundant in the northern portion of the SAB, with density of individuals decreasing with decreasing latitude.

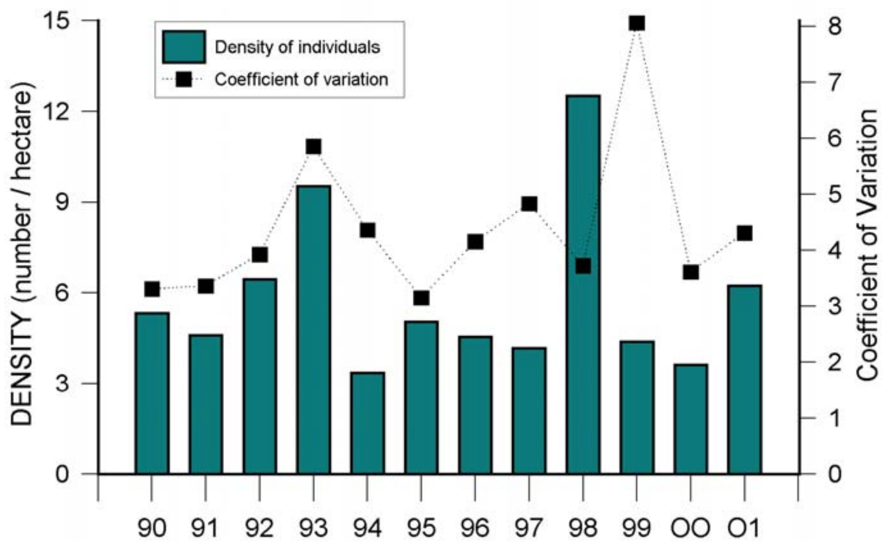

Figure 10. Annual densities of *Cynoscion regalis*.

Table 9 . Estimates of density (number of individuals/hectare) in 2001.

Cynoscion regalis

	Spring	Summer	Fall	Region
Raleigh Bay	75.1	4.1	6.6	29.2
Onslow Bay	6.2	10.4	1.0	6.0
Long Bay	1.5	9.0	0.3	3.6
South Carolina	0.4	6.3	2.0	2.9
Georgia	1.3	7.9	1.9	3.9
Florida	8.4	1.8	1.6	4.0
Season	9.9	6.7	1.9	6.2

A total of 800 otolith (spring=305, summer=306, fall=189) and 447 gonad samples from weakfish were taken in 2001. Weakfish of ages 0 and 1 constituted the largest percentage (84%) of the individuals aged, age 2 made up 15%, and age 3 made up only 1%. Weakfish collected in SEAMAP samples ranged from 108 to 273 mm TL for age 0 fish, 133 to 299 mm TL for age 1, 181 to 367 mm TL for age 2, and 246 to 370 mm TL for age 3. No age 4 specimens were collected and only one age 5 individual (369 mm TL) was taken in SEAMAP samples.

Total lengths of *Cynoscion regalis* ranged from 8 to 37 cm ($\bar{x}$ = 18.7). Length was significantly different among seasons ($X^2 = 384$, $p < 0.0001$). Mean length decreased from spring to summer, indicating the recruitment of YOY individuals, and increased in fall as the result of subsequent juvenile growth (Figure 11). The percentage of age 0 fish increased seasonally from none in spring to 90% of the weakfish sampled in fall. The spring length-frequency distribution comprised mostly age 1 and a few age 2 and 3 fish. The inclusion of smaller specimens in summer collections resulted in a length-frequency distribution representing mostly age 1 fish that were spawned late and age 0 specimens.

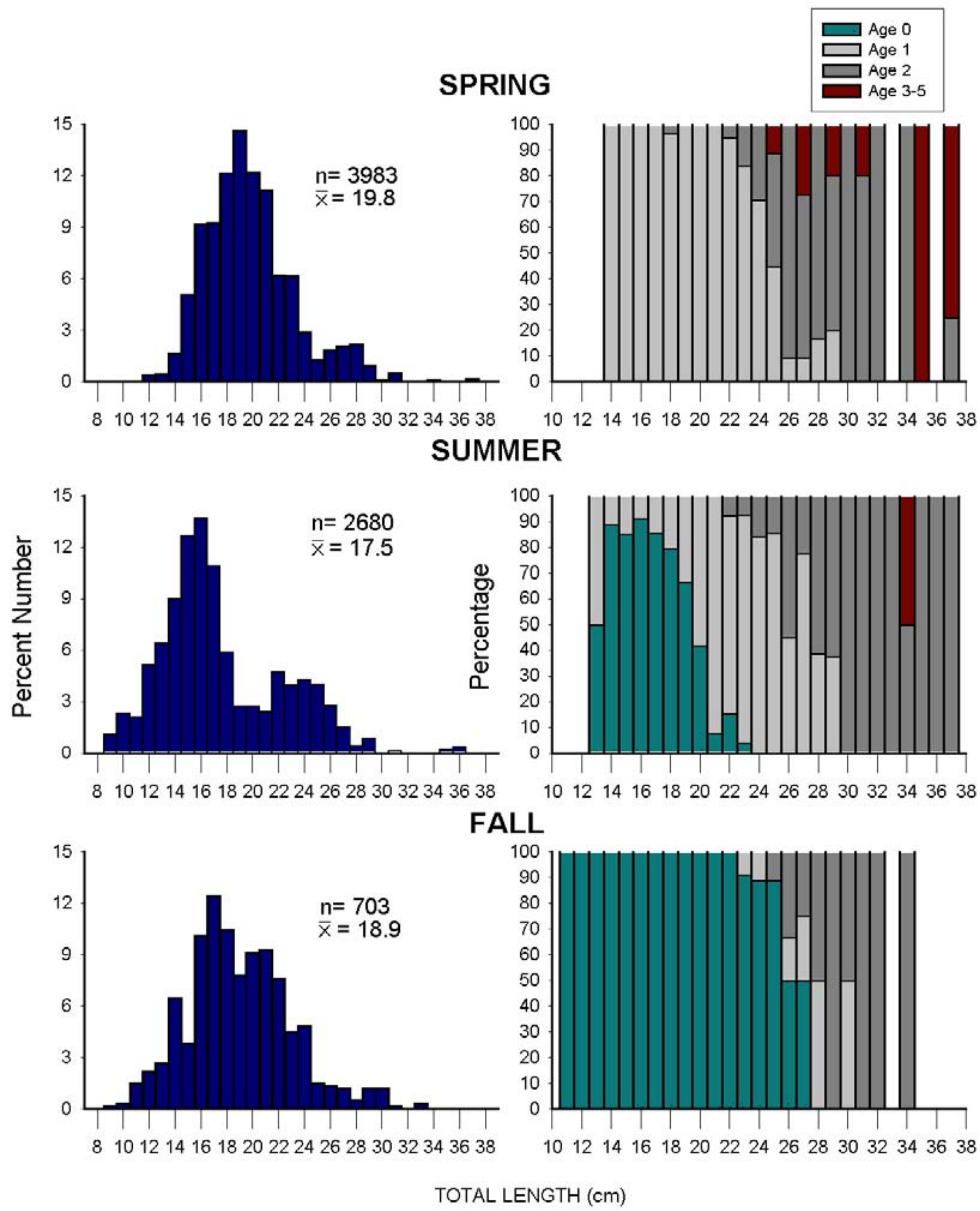

Figure 11. Seasonal length-frequencies and age composition of *Cynoscion regalis* in 2001.

Mean length also varied significantly among regions ($X^2 = 571$, $p < 0.0001$), with larger mean lengths occurring in Onslow Bay and off Florida (Figure 12). The length-frequency distributions of weakfish in all regions except Raleigh Bay and Florida comprised primarily individuals taken in summer, when smaller specimens were collected. Seasonal abundance in the Raleigh Bay and Florida waters peaked in spring, when larger specimens were caught, and decreased from spring to fall.

Age composition was very similar among male and female weakfish. More than 60% of the individuals sampled were female. Most of the females (70%) had immature or developing ovaries, whereas more than 80% of the males were reproductively mature.

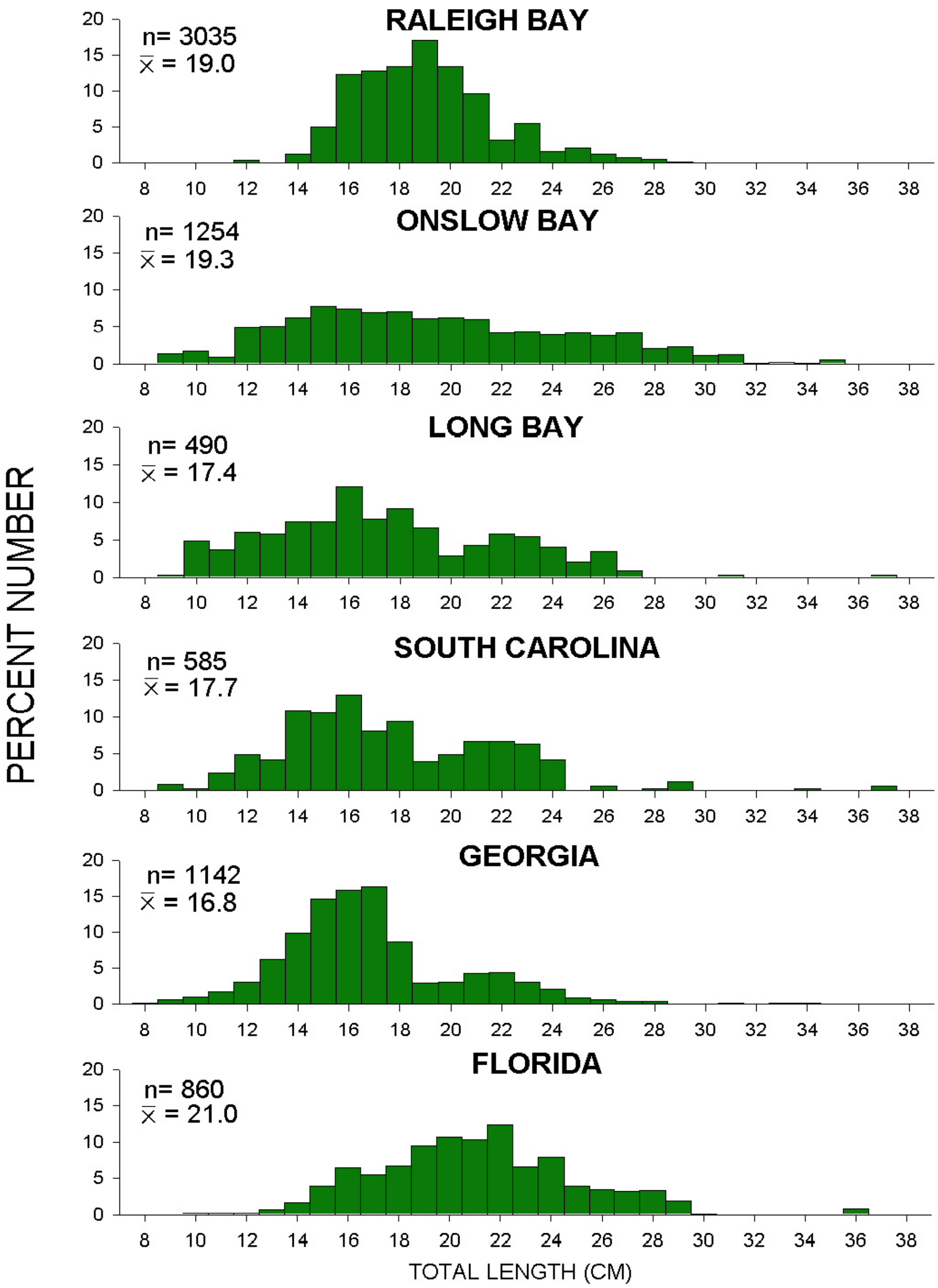

Figure 12. Regional length-frequencies of *Cynoscion regalis* in 2001.

Leiostomus xanthurus

The spot ranges from Massachusetts throughout the Gulf of Mexico to the mouth of the Rio Grande (Chao, 1978) and is one of the most widely occurring and abundant fishes in the coastal waters of the South Atlantic Bight (Wenner and Sedberry, 1989). Spot migrate offshore to spawn in early November through late January (Flores-Coto and Warlen, 1993) and are subjected to heavy commercial and recreational fishing pressure at that time. Historically, the largest spot fishery has been the commercial gill-net fishery, which has contributed to the great fluctuations in commercial landings over the last 60 years (Mercer, 1989).

Leiostomus xanthurus was the third most abundant species collected by SEAMAP-SA in 2001. The 54,333 (CV=2.9; 46.0 individuals/ha) spot collected weighed 2,485 kg (2.1 kg/ha) and constituted more than 12% of the total number of individuals taken in SEAMAP trawls in 2001. Density of individuals peaked in 1990 and 1991 and reached its lowest levels in 1998 and 1999 (Figure 13). In 2001 the greatest seasonal density of abundance occurred in summer (Table 10). The greatest regional densities were observed in the northern South Atlantic Bight.

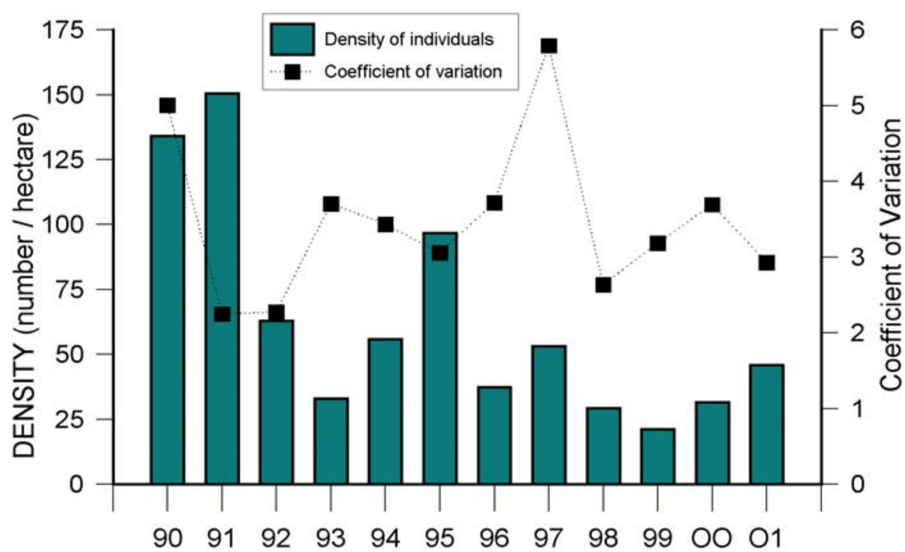

Figure 13. Annual densities of *Leiostomus xanthurus*.

Table 10 . Estimates of density (number of individuals/hectare) in 2001.

Leiostomus xanthurus

	Spring	Summer	Fall	Region
Raleigh Bay	73.1	165.4	4.7	84.9
Onslow Bay	48.8	109.9	6.5	56.1
Long Bay	135.7	22.9	22.3	62.7
South Carolina	2.2	84.8	4.0	30.3
Georgia	2.8	104.9	2.6	38.7
Florida	10.8	89.3	3.7	35.1
Season	34.4	95.8	6.1	46.0

Total lengths of spot from the SEAMAP-SA survey ranged from 8 to 26 cm, with a mean length of 14.5 cm. Lengths varied significantly among seasons ($X^2 = 2762$, $p < 0.0001$). Mean length decreased from spring to summer, indicating the recruitment of YOY individuals, and increased in fall as the result of subsequent juvenile growth (Figure 14).

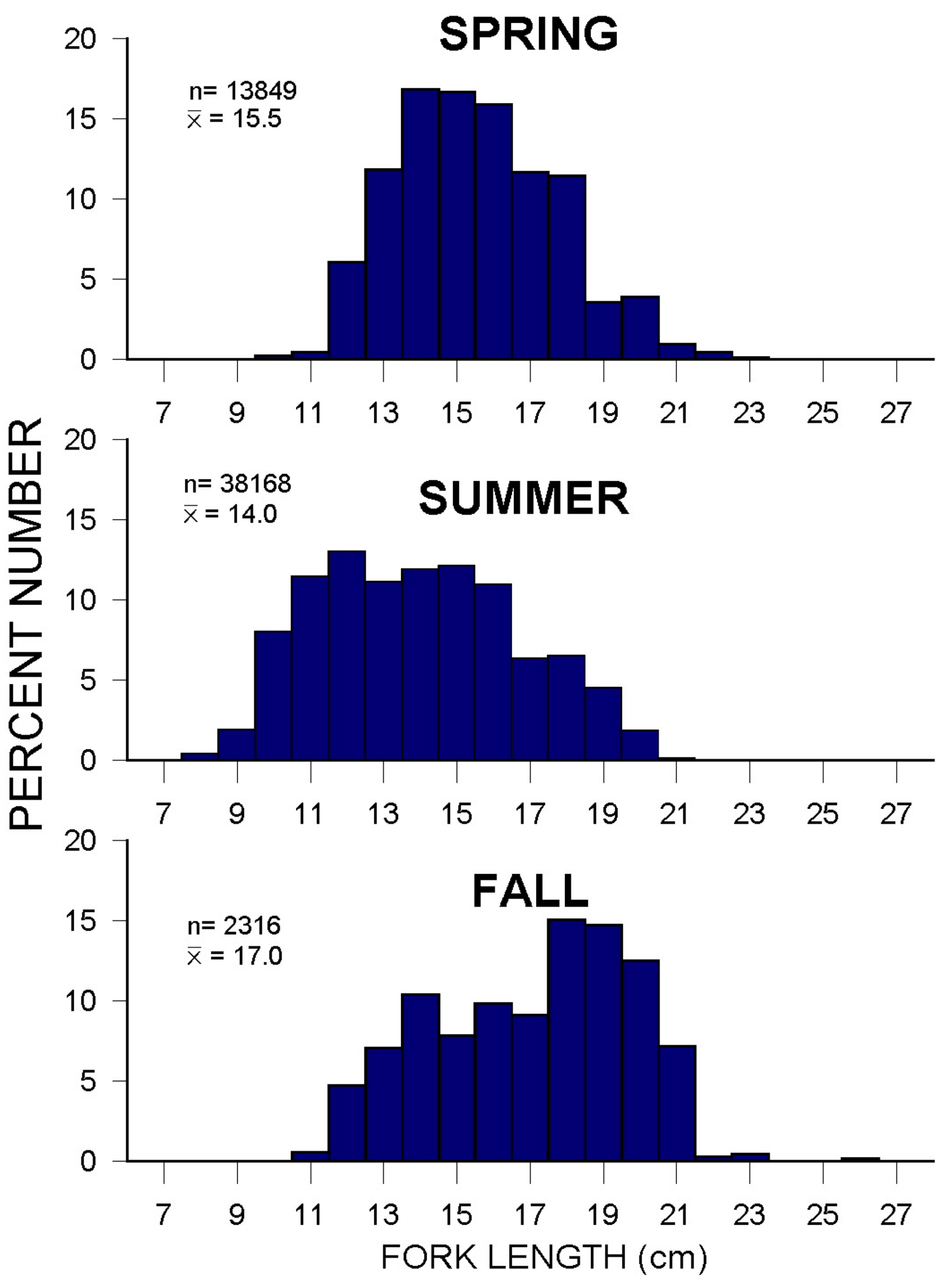

Figure 14. Seasonal length-frequencies of *Leiostomus xanthurus* in 2001.

Length also varied significantly among regions ($X^2 = 3227$, $p < 0.0001$). The mean length of spot was greatest in waters off South Carolina (Figure 15). The length-frequency distribution of spot represents primarily specimens captured during the summer cruises in all regions, except Long Bay. In the northern regions (Raleigh Bay, Onslow Bay, Long, Bay), with the exception of a few individuals, smaller specimens in the length-frequency distribution were collected during summer. Larger specimens were collected during fall. In waters off South Carolina and Georgia, smaller specimens were taken in both spring and summer and larger fish were taken during all three seasons. In waters off Florida, small specimens were taken in summer and larger specimens were caught in spring.

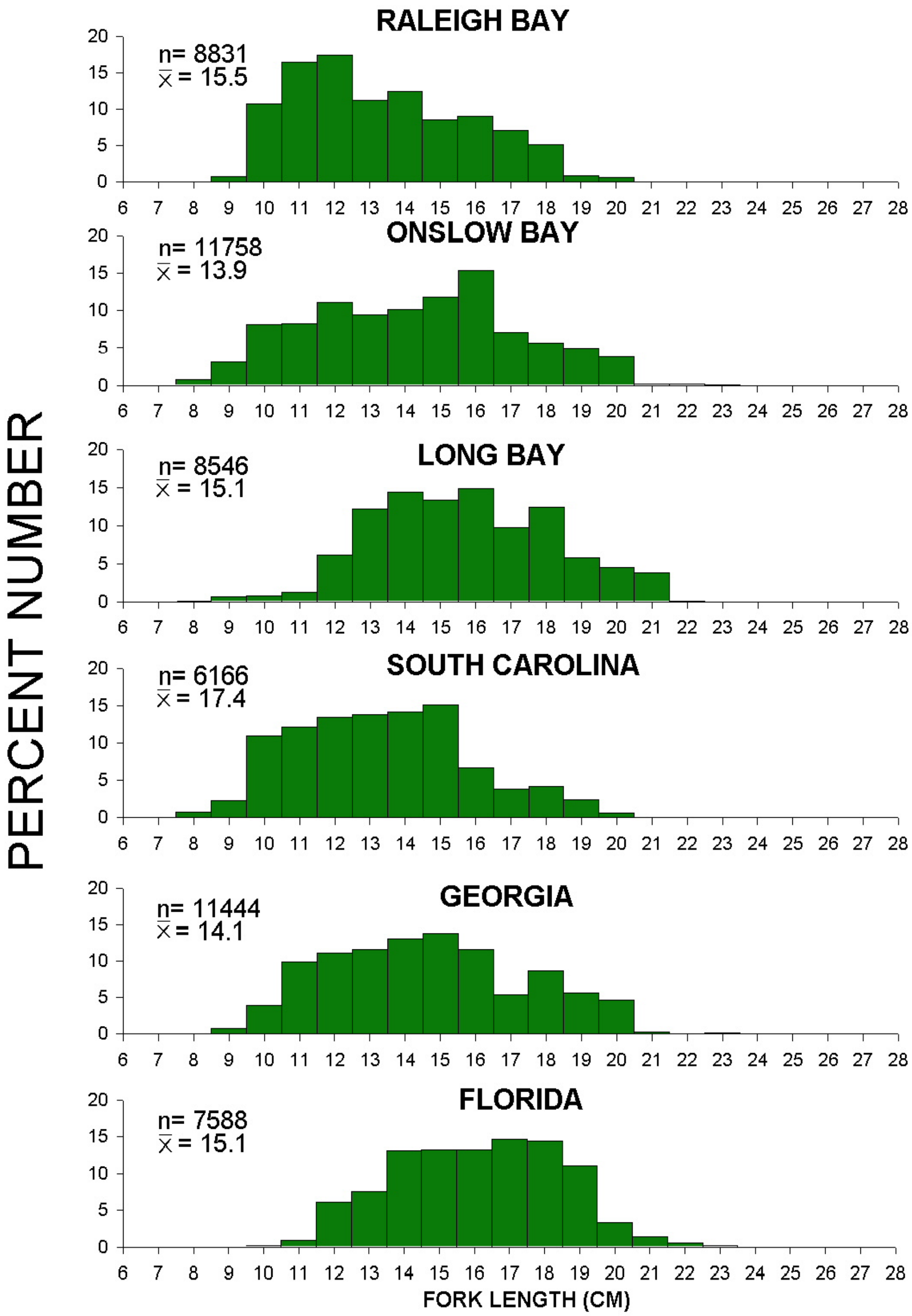

Figure 15. Regional length-frequencies of *Leiostomus xanthurus* in 2001.

Menticirrhus americanus

The southern kingfish ranges from New England to Brazil (Chao 1978) and is the most abundant species in the genus occurring in the South Atlantic Bight. Southern kingfish attain the largest maximum body size of the three species of *Menticirrhus* and are important both commercially and recreationally.

SEAMAP-SA strata produced a total of 7,105 southern kingfish (CV=1.7; 6.0 individuals/ha) weighing 690 (0.6 kg/ha). Although density of individuals does not fluctuate a great deal annually, density did decrease in 2001 (Figure 16). Density was greatest in summer and in Raleigh Bay (Table 11). The southern kingfish exhibited the highest percent occurrence of all priority species, being present in approximately 83% of all tows.

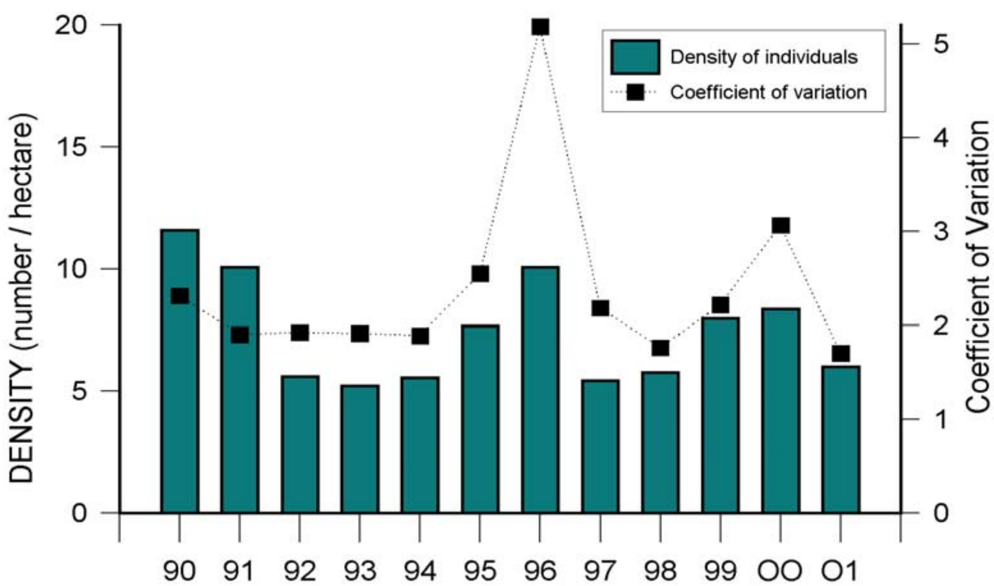

Figure 16. Annual densities of *Menticirrhus americanus*.

Table 11 . Estimates of density (number of individuals/hectare) in 2001.

Menticirrhus americanus

	Spring	Summer	Fall	Region
Raleigh Bay	19.9	13.9	1.1	12.1
Onslow Bay	8.5	2.3	2.9	4.5
Long Bay	1.1	2.1	5.2	2.7
South Carolina	1.5	3.7	7.4	4.1
Georgia	4.4	10.3	6.4	7.4
Florida	6.5	11.7	2.4	6.9
Season	6.0	7.4	4.6	6.0

Total lengths of *Menticirrhus americanus* ranged from 9 to 37 cm ($\bar{x}$ = 21.5). Length was significantly different among seasons ($X^2 = 174$, $p < 0.0001$). Mean length decreased from spring to fall, representing the recruitment of YOY individuals (Figure 17).

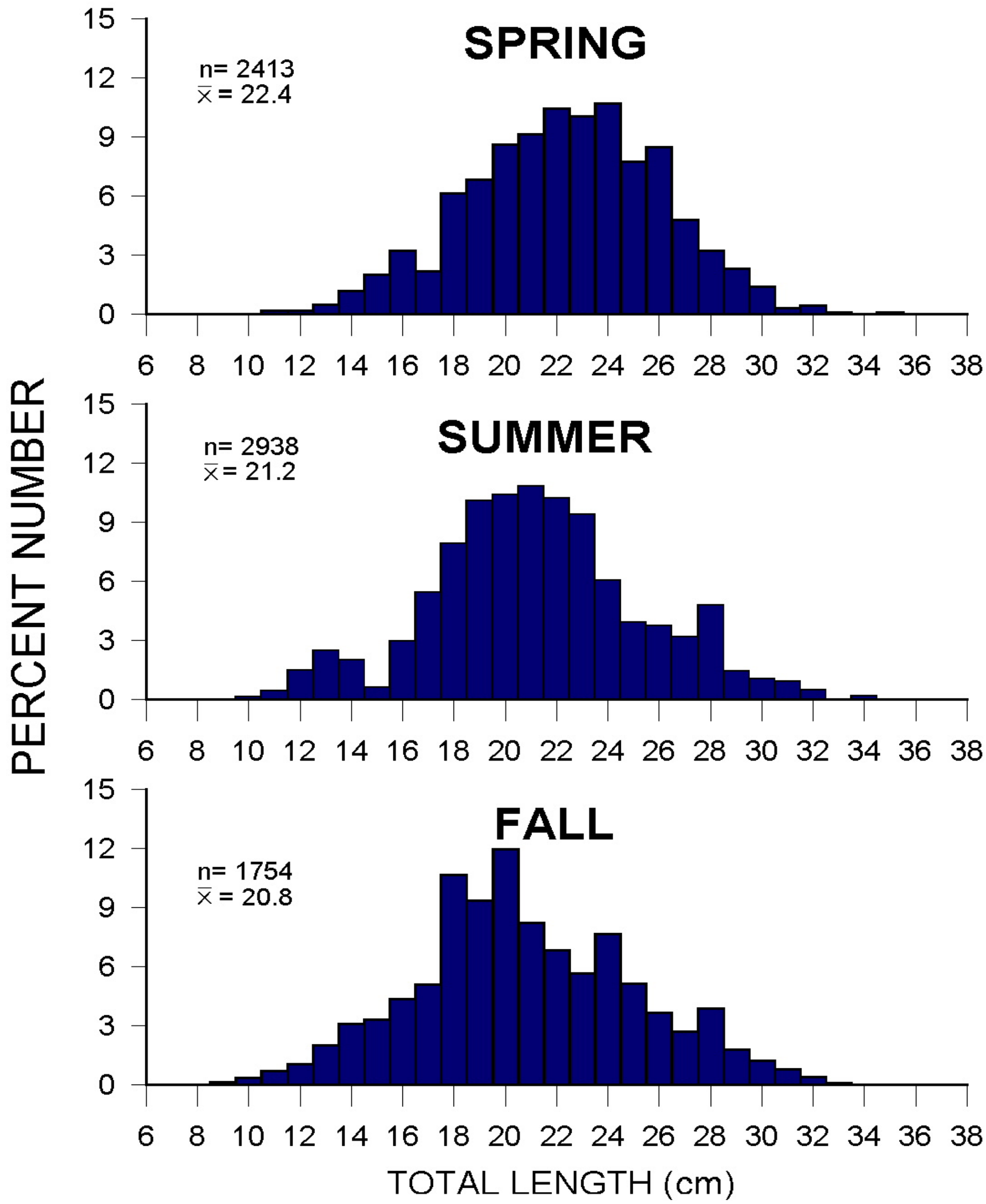

Figure 17. Seasonal length-frequencies of *Menticirrhus americanus* in 2001.

Length also varied significantly among regions ($X^2 = 817$, $p < 0.0001$), with greatest mean length observed in waters off Florida (Figure 18). The seasonal length-frequency distributions of southern kingfish were similar throughout the SAB, with most of the smaller fish collected in summer and fall collections.

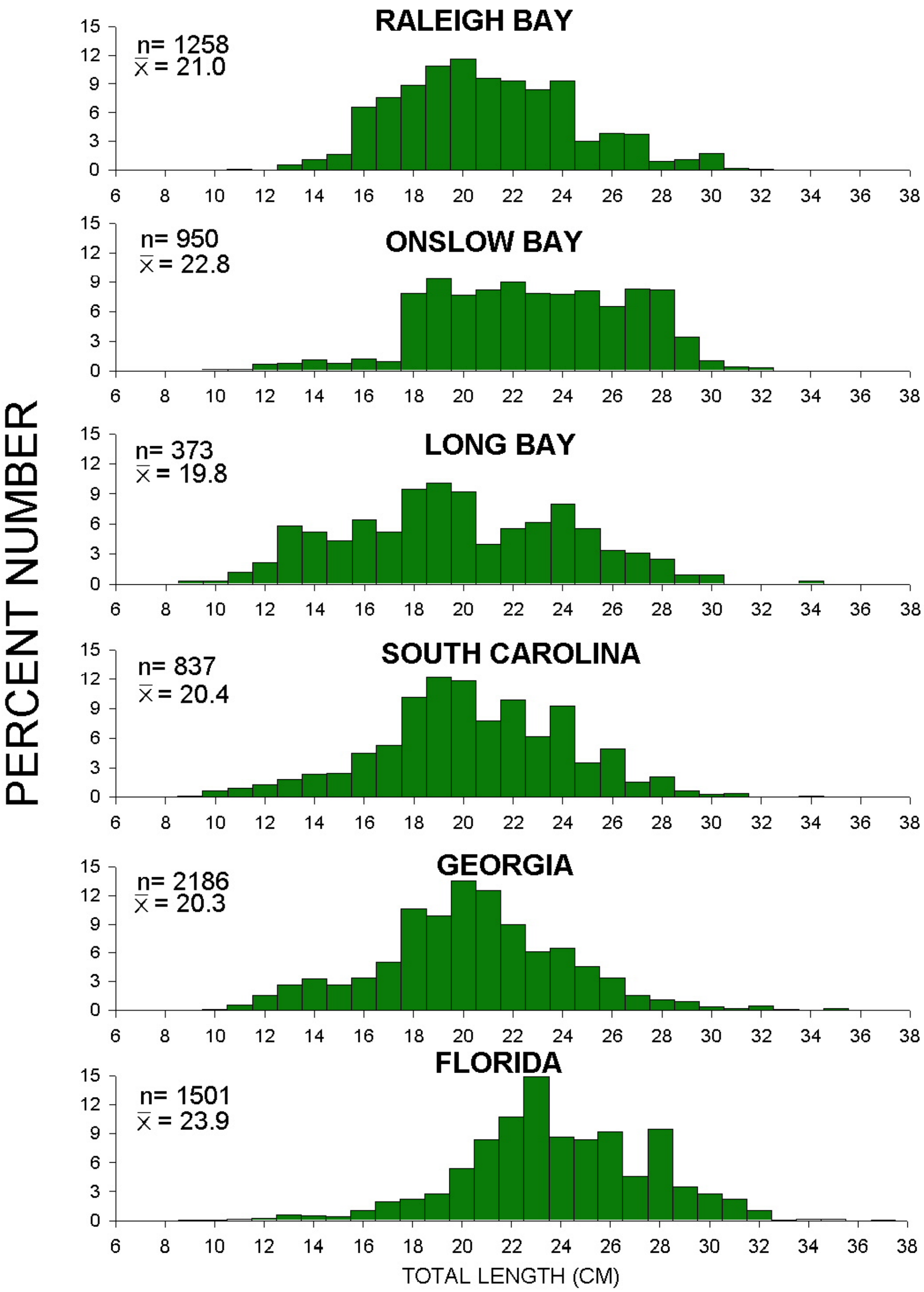

Figure 18. Regional length-frequencies of *Menticirrhus americanus* in 2001.

Menticirrhus littoralis

Gulf kingfish are found along the western Atlantic coast from the Chesapeake Bay to south Florida as well as the Gulf of Mexico, Central American, and S. American coasts from south Florida to Rio Grande, Brazil (Chao, 1978). This species is a bottom feeder and is found over muddy and sandy bottom in coastal waters, but is also abundant in the surf zone. The young of this species can sometimes be found in the estuaries.

SEAMAP-SA strata yielded a total of 179 gulf kingfish (CV=3.8; 0.2 individuals/ha) weighing 29 kg (0.02 kg/ha) in 2001. Density of individuals for *Menticirrhus littoralis* peaked in 1996 and 2000 (Figure 19). In 2001 density was greatest in spring and summer (Table 12). Gulf kingfish were most abundant in Florida waters. Total lengths of *Menticirrhus littoralis* ranged from 14 to 38 cm ($\bar{x}$ = 25.2), with greatest mean length in fall and off Georgia.

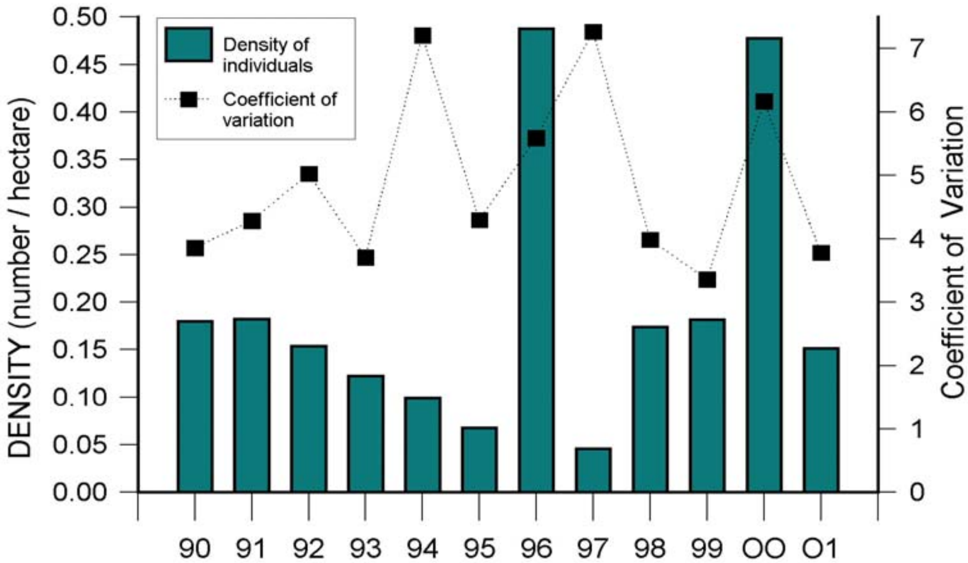

Figure 19. Annual densities of *Menticirrhus littoralis*.

Table 12 . Estimates of density (number of individuals/hectare) in 2001.

Menticirrhus littoralis

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0	0
Onslow Bay	0.01	0.01	0	0.01
Long Bay	0	0	0.05	0.01
South Carolina	0.07	0.03	0.02	0.04
Georgia	0.01	0.07	0.07	0.05
Florida	1.3	0.7	0.1	0.7
Season	0.2	0.2	0.05	0.2

Menticirrhus saxatilis

Northern kingfish inhabit the western Atlantic and Gulf of Mexico coasts from the Gulf of Maine to the Yucatan this fish can be found bottom feeding over sandy and muddy bottoms in near shore waters, as well as being prominent in the surf zone (Chao, 1978). Young may be found in the estuaries.

SEAMAP-SA strata yielded a total of 103 northern kingfish (CV=7.2; 0.09 individuals/ha) weighing 11 kg (0.009 kg/ha) in 2001. Density of individuals has declined since the beginning of the survey, with the exception of 1996 when a secondary peak in abundance was observed (Figure 35). 2001 estimates increased over levels observed in the past four years. Density was greatest in fall (Table 13). Northern kingfish were taken only in the northern portion of the SAB. Density of individuals was greatest in Raleigh Bay, where 64% of all northern kingfish were collected in 2001. Total lengths of *Menticirrhus saxatilis* ranged from 13 to 33 cm ($\bar{x}$ = 21.3), with greatest mean length in fall and in Raleigh Bay.

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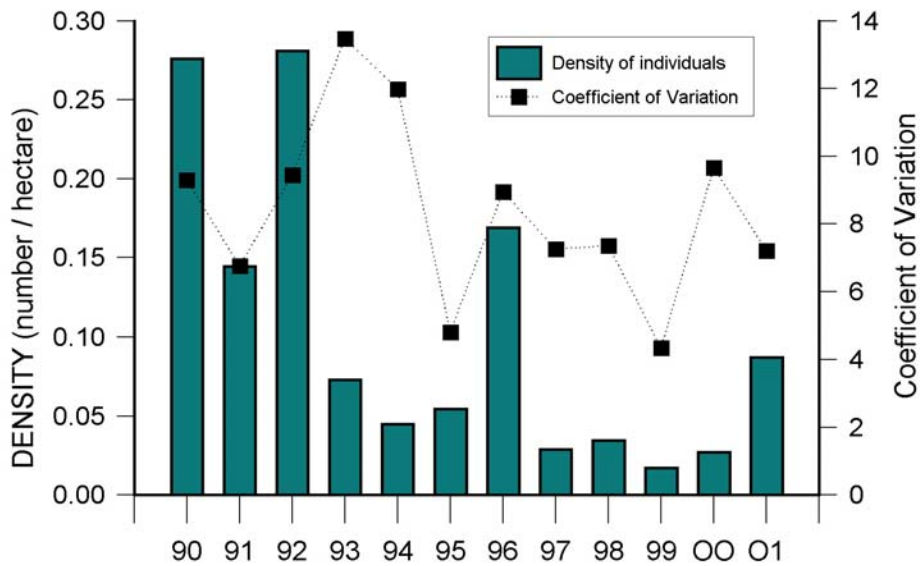

Figure 20. Annual densities of *Menticirrhus saxatilis*.

Table 13 . Estimates of density (number of individuals/hectare) in 2001.

Menticirrhus saxatilis

	Spring	Summer	Fall	Region
Raleigh Bay	0	0.1	2.2	0.6
Onslow Bay	0	0.1	0.4	0.2
Long Bay	0	0.09	0	0.03
South Carolina	0	0	0	0
Georgia	0	0	0	0
Florida	0	0	0	0
Season	0	0.04	0.2	0.09

Micropogonias undulatus

The Atlantic croaker ranges from Argentina to the Gulf of Maine (Chao, 1978). This species is one of the most abundant finfish species in trawl catches in the SAB (Wenner and Sedberry, 1989) and is considered to be an excellent food fish. In addition to trawls, croaker are also caught with pound nets, gill-nets, trammel nets and seines, and also on hook-and-line by sports fishermen (Chao, 1978).

Micropogonias undulatus was the second most abundant species collected in SEAMAP-SA samples in 2001. The 72,994 individuals (CV=2.8), weighing 3451 kg, made up17%of the total number of specimens taken in SEAMAP strata. Density estimates for the entire SAB were 61.2 individuals/ha and 2.9 kg/ha. Density of individuals peaked in 1991-1992 and dipped to the lowest level in 1997 (Figure 21). With the exception of Raleigh Bay, seasonal densities of individuals were greatest in summer. Regional densities were highest off Florida and in Onslow Bay, primarily due to large catches of Atlantic croaker in summer (Table 14).

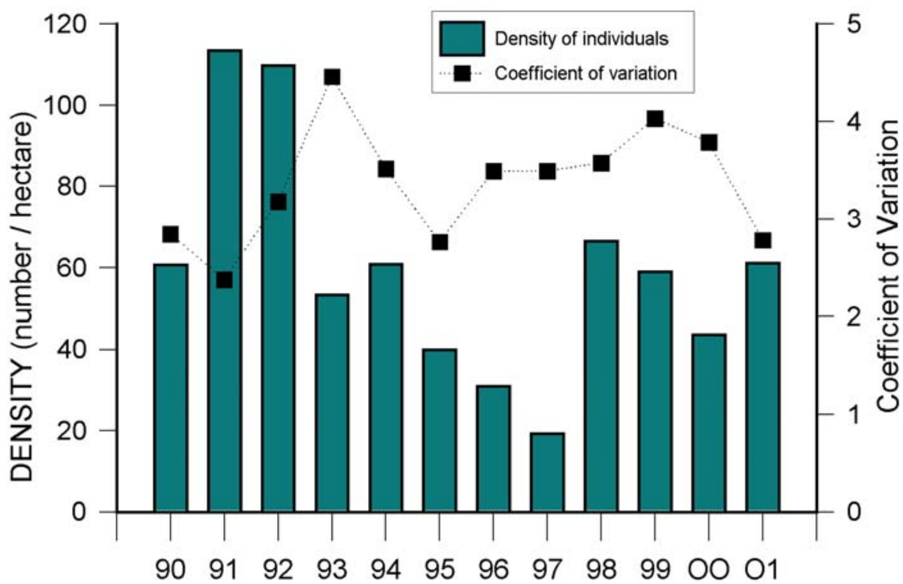

Figure 21. Annual densities of *Micropogonias undulatus*.

Table 14. Estimates of density (number of individuals/hectare) in 2001.

Micropogonias undulatus

	Spring	Summer	Fall	Region
Raleigh Bay	61.8	30.9	2.8	33.0
Onslow Bay	31.8	225.0	45.2	102.3
Long Bay	21.2	127.3	4.6	50.8
South Carolina	5.1	46.4	5.9	19.1
Georgia	0.8	107.9	3.1	39.3
Florida	18.0	316.2	6.7	115.4
Season	18.0	151.9	11.8	61.1

In 2001, a total of 807 otolith (spring=141, summer=440, fall=226) and 371 gonad samples were taken from Atlantic croaker. The majority of the Atlantic croaker sampled for ageing were ages 0 and 1 (85%), followed by age 2 specimens (10%), and age 3 fish (5%). Only one age 4 fish and three age 5 fish were sampled. Atlantic croaker ranged from 115 to 248 mm TL for age 0, from 137 to 362 mm TL for age 1, from 159 to 272 for age 2, and from 200 to 253 mm TL for age3. Only one age 4 individual was collected (216 cm) and three age 5 fish (222 to 238 mm) were taken in SEAMAP samples.

Total lengths of Atlantic croaker ranged from 3 to 27 cm ($\bar{x}$ = 16.9 cm). Lengths differed significantly among seasons ($X^2 = 1552$, $p < 0.0001$). The mean length of Atlantic croaker increased from summer to fall (Figure 22). The percentage of age 0 fish increased seasonally from none in spring to 70% of the Atlantic croaker sampled in fall. The spring length-frequency distribution comprised mostly age 1 and a few age 2 and 3 fish. The inclusion of smaller specimens in summer collections resulted in a length-frequency distribution representing mostly age 1 fish that were spawned late and age 0 specimens. Fall collections consisted of mostly age 0, age 1, and a few larger specimens.

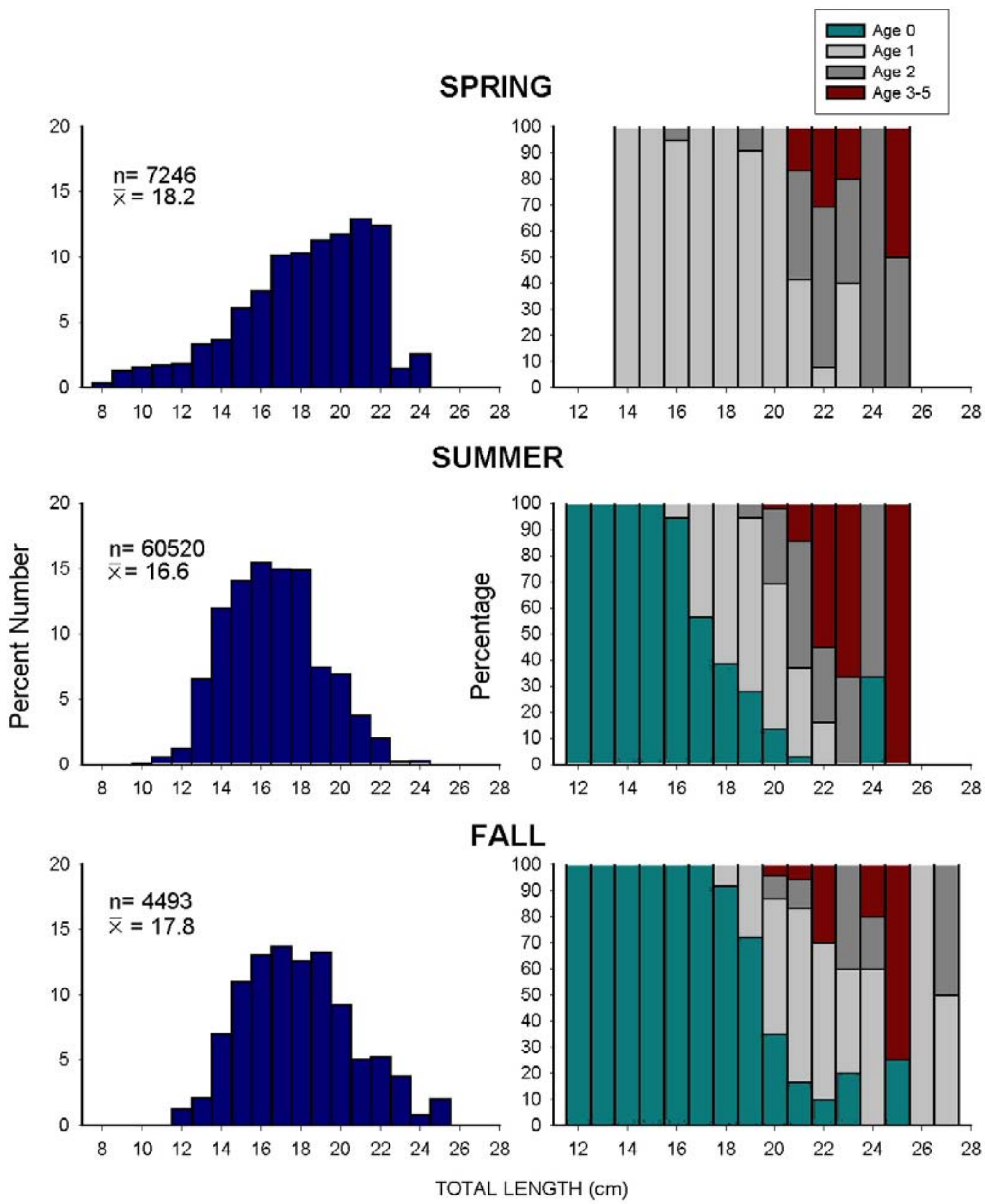

Figure 22. Seasonal length-frequencies and age composition of *Micropogonias undulatus* in 2001.

Based on length-at-age data, in all seasons the numerically dominant fish were probably Age 0 and Age I, with a few Age II fish present. Length also varied significantly among regions (X^2 = 8882, p < 0.0001), and mean lengths ranged from 15.5 cm off South Carolina to 19.3 cm in Raleigh Bay (Figure 23). The length-frequency distribution in Raleigh Bay comprised primarily (65%) of fish caught in spring, the season during which the majority of the smaller specimens were taken. In all regions to the south, the length-frequency distributions primarily represent fish caught in summer.

Age composition was very similar among male and female Atlantic croaker. More than 62% of the individuals sampled were female. Most of the females (80%) had immature or developing ovaries and most (60%) of the males were reproductively immature as well.

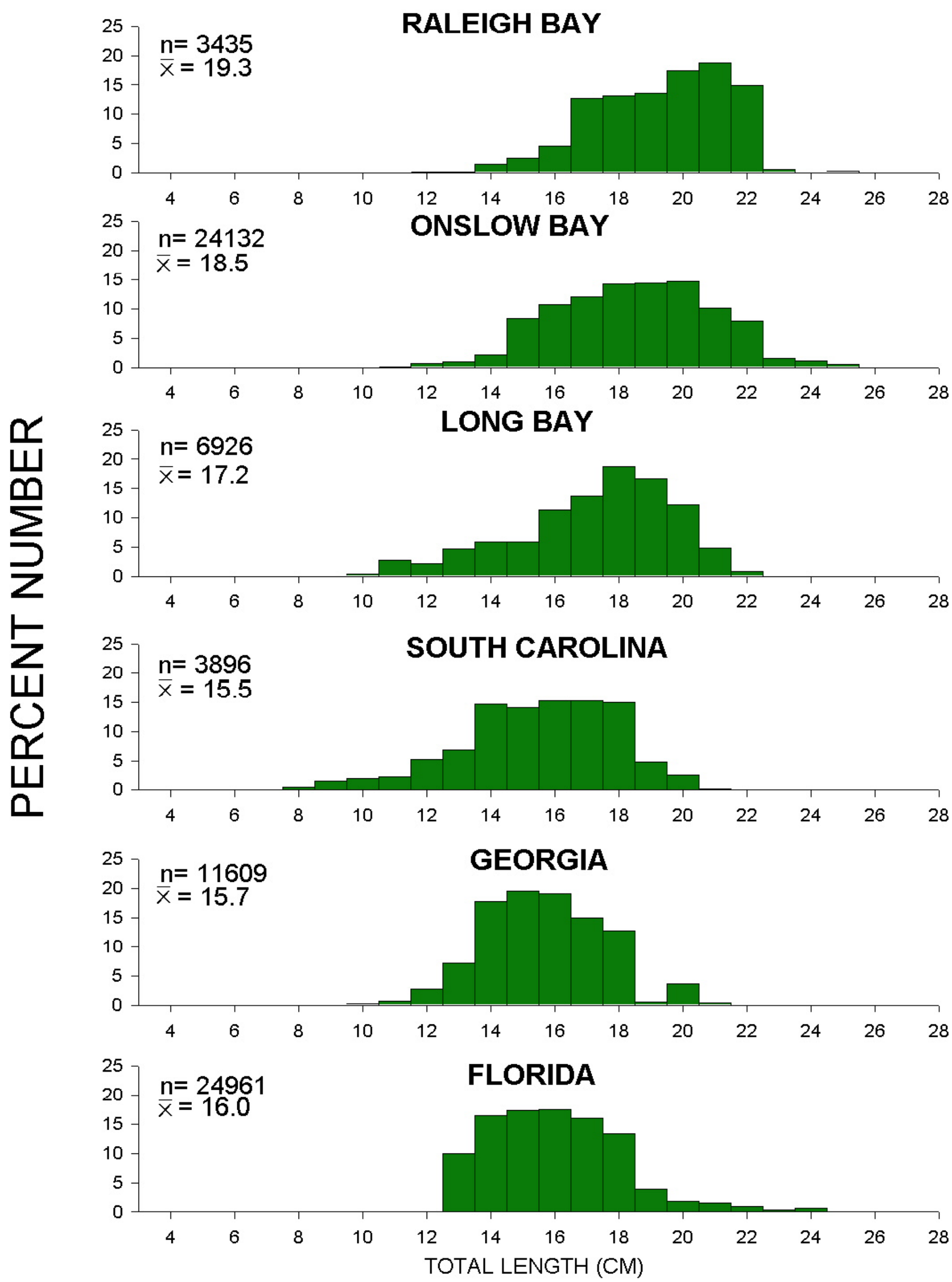

Figure 23. Regional length-frequencies of *Micropogonias undulatus* in 2001.

Mycteroperca microlepis

The gag grouper is found along the western Atlantic coast of the Southeastern U.S. and is scarce in Bermuda (Smith, 1978). The gag, *Mycteroperca microlepis*, has been rare in SEAMAP-SA collections (SEAMAP-SA/SCMRD, 2000). No gag grouper were collected in 2001.

Paralichthys albigutta

The gulf flounder is found along the western Atlantic and Gulf of Mexico coasts of the US from North Carolina to Texas, and is generally found in depths less than 150 meters (Gutherz, 1967; Randall and Vergara, 1978)

The gulf flounder, *Paralichthys albigutta*, generally exhibits low abundance in SEAMAP-SA collections. Only 23 individuals (CV=6.4; 0.02individuals/ha) weighing 6 kg (0.005 kg/ha) were taken in 2001. Abundance of gulf flounder was greatest in 1992 and lowest in 1997-1998 (Figure 24). Gulf flounder were most abundant in fall in Raleigh and Onslow Bays (Table 15). Lengths ranged from 18 to 38 cm ($\bar{x}$ = 28.3), with greatest mean length in spring and off Georgia.

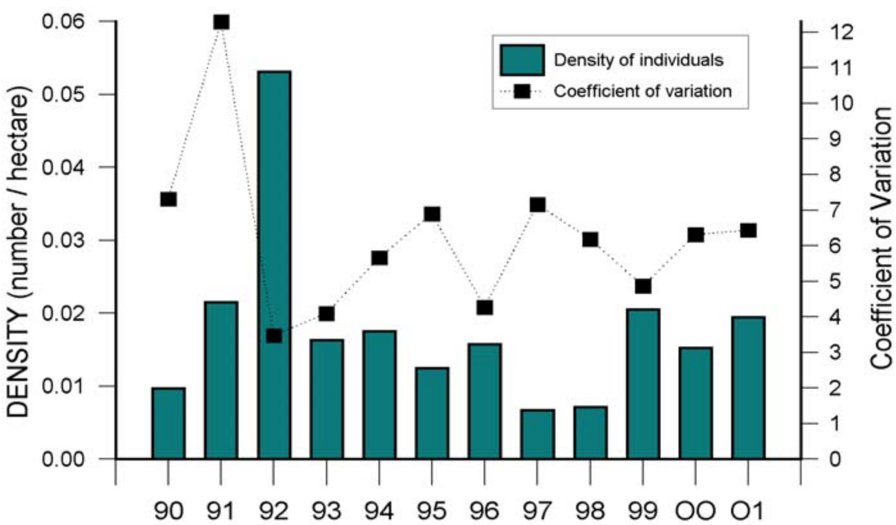

Figure 24. Annual densities of *Paralichthys albigutta*.

Table 15. Estimates of density (number of individuals/hectare) in 2001.

Paralichthys albigutta

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0.2	0.05
Onslow Bay	0.01	0.03	0.1	0.06
Long Bay	0.04	0	0	0.01
South Carolina	0	0	0	0
Georgia	0	0	0.02	0.007
Florida	0.01	0.01	0	0.009
Season	0.01	0.008	0.04	0.02

Paralichthys dentatus

Summer flounder are distributed along the Atlantic coast of the U.S., from Maine to Florida (Gutherz, 1967; Randall and Vergara, 1978) Unlike *P. lethostigma*, which prefer muddy substrates in low salinity areas, summer flounder prefer sandy substrate in highly saline estuarine areas (Powell and Schwartz, 1977). Summer flounder are actively sought by both commercial and recreational fishermen and are taken year-round in South Carolina, incidental to the shrimp fishery (Keiser, 1976).

SEAMAP-SA strata yielded a total of 413 summer flounder (CV=2.3; 0.3 individuals/ha) weighing 58 kg (0.05 kg/ha). Density of individuals has not varied much annually, with the exception of a peak in abundance in 1992 (Figure 25). Density was lowest in spring and increased in subsequent seasons in the northern SAB (Table 16). Summer flounder were most abundant in the northern portion of the SAB, with density of individuals decreasing with decreasing latitude. Total lengths of *Paralichthys dentatus* ranged from 12 to 48 cm ($\bar{x}$ = 23.3); however, seasonal mean length did not vary greatly. Greatest regional mean lengths occurred in the northern SAB.

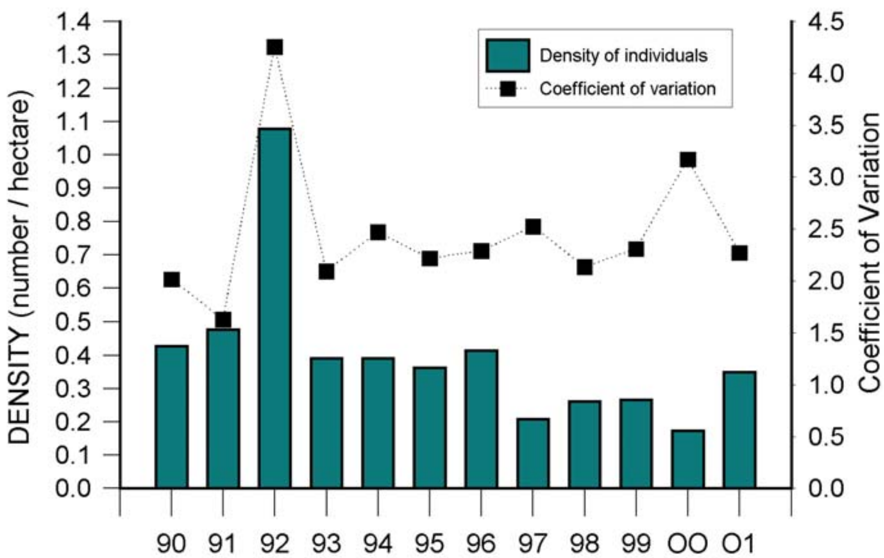

Figure 25. Annual densities of *Paralichthys dentatus*.

Table 16. Estimates of density (number of individuals/hectare) in 2001.

Paralichthys dentatus

	Spring	Summer	Fall	Region
Raleigh Bay	0.3	1.2	1.3	0.8
Onslow Bay	0.2	0.7	1.2	0.7
Long Bay	0.02	0.3	0.4	0.2
South Carolina	0.2	1.0	0.2	0.4
Georgia	0.02	0.5	0.02	0.2
Florida	0.01	0.04	0	0.02
Season	0.1	0.5	0.4	0.3

Paralichthys lethostigma

The southern flounder is a resident of the Atlantic and Gulf coasts of the U.S., and ranges from North Carolina to Texas (Randall and Vergara, 1978). Older juveniles and adults move offshore to deeper marine waters in the winter while juveniles (young-of-the-year) overwinter in the estuaries (Powell and Schwartz, 1977). *Paralichthys lethostigma* prefers muddy substrates in low salinity estuarine areas (Powell and Schwartz, 1977; Randall and Vergara, 1978).

SEAMAP-SA strata yielded a total of 73 southern flounder (CV=5.5; 0.06 individuals/ha) weighing 21 kg (0.02 kg/ha) in 2001. Historically, density of individuals has not varied much annually (Figure 26). Density was greatest in spring and southern flounder were most abundant in waters off South Carolina (Table 17). Total lengths of *Paralichthys lethostigma* ranged from 18 to 42 cm ($\bar{x}$ = 28.8).

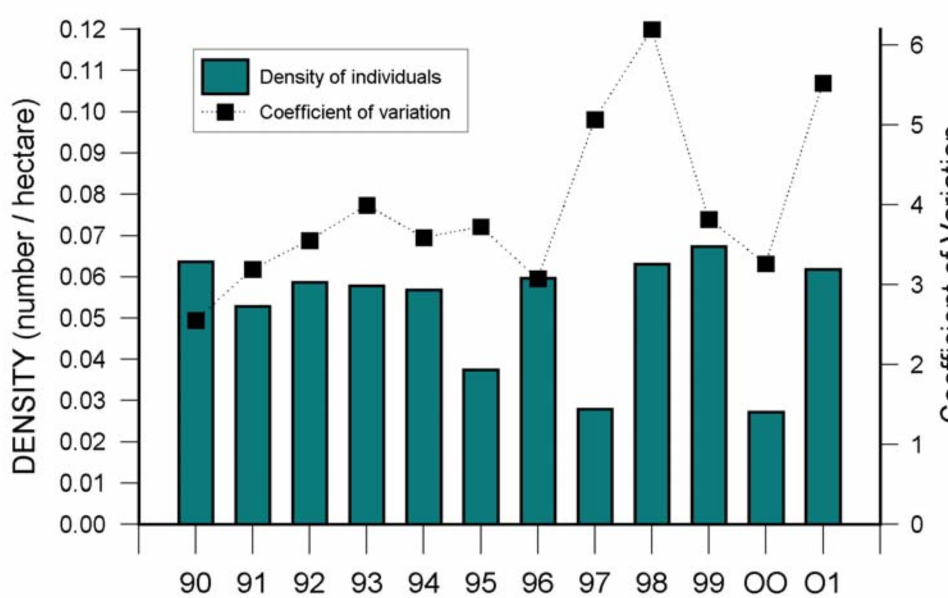

Figure 26. Annual densities of *Paralichthys lethostigma*.

Table 17 . Estimates of density (number of individuals/hectare) in 2001.

Paralichthys lethostigma

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0.04	0.01
Onslow Bay	0.1	0.01	0.06	0.06
Long Bay	0.08	0.04	0.02	0.05
South Carolina	0.3	0.04	0.03	0.1
Georgia	0.01	0.08	0.02	0.04
Florida	0.04	0.2	0.01	0.07
Season	0.09	0.07	0.03	0.06

Peprilus alepidotus

The harvest fish occurs from the Chesapeake through the Gulf of Mexico and Caribbean Islands down to South America (Horn, 1970; Vergara, 1978). They are harvested as foodfish in North Carolina (Horn, 1970) and Florida (Vergara, 1978).

SEAMAP-SA strata yielded a total of 4,342 harvestfish (CV=2.8; 3.7 individuals/ha) weighing 204 kg (0.2 kg/ha). Density of individuals peaked in 1991 and 1995 (Figure 27). Annual peaks in abundance reflect large catches of harvestfish in fall collections (SEAMAP-SA/SCMRD, 2000). Harvestfish were most abundant in the southern portion of the SAB, especially off Georgia and Florida in fall (Table 18), whereas density was greatest in northern SAB in spring. Fork lengths of *Peprilus alepidotus* ranged from 3 to 19 cm ($\bar{x}$ = 9.9).

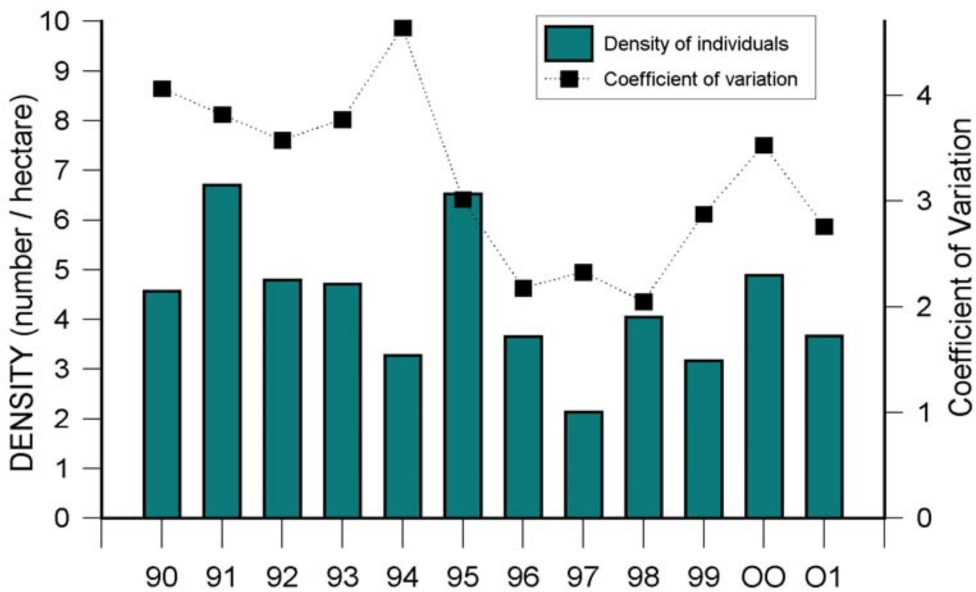

Figure 27. Annual densities of *Peprilus alepidotus*.

Table 18 . Estimates of density (number of individuals/hectare) in 2001.

Peprilus alepidotus

	Spring	Summer	Fall	Region
Raleigh Bay	0.4	1.0	0.1	0.5
Onslow Bay	1.9	0.9	1.3	1.4
Long Bay	3.3	0.9	2.9	2.4
South Carolina	1.6	3.1	4.8	3.1
Georgia	1.0	1.7	10.2	4.5
Florida	1.4	1.4	21.5	7.9
Season	1.6	1.6	8.1	3.7

Peprilus triacanthus

The butterfish ranges from Nova Scotia throughout the Gulf of Mexico to the Yucatan Peninsula (Vergara, 1978). Generally found in waters less than 55 m (Vergara, 1978), this schooling pelagic species migrates to offshore waters in the colder months (Horn, 1970). The young tend to be associated with floating plants and debris, and jellyfish. They are taken commercially and marketed as a food fish.

Peprilus triacanthus was the fourth most abundant species collected in SEAMAP-SA samples in 2001. The 41,115 (CV=4.3; 34.8 individuals/ha) butterfish collected weighed 626 kg (0.5 kg/ha) and constituted more than 9% of the total number of individuals taken in SEAMAP trawls in 2001. Density of individuals in 2001 was the highest estimate observed in the history of the SEAMAP-SA project (Figure 28). Density was greatest in spring in Raleigh and Onslow Bays (Table 19). These large catches of butterfish were associated with equally large catches of jellies. Butterfish are generally most abundant in the northern portion of the SAB, with density decreasing with decreasing latitude (SEAMAP-SA/SCMRD, 2000).

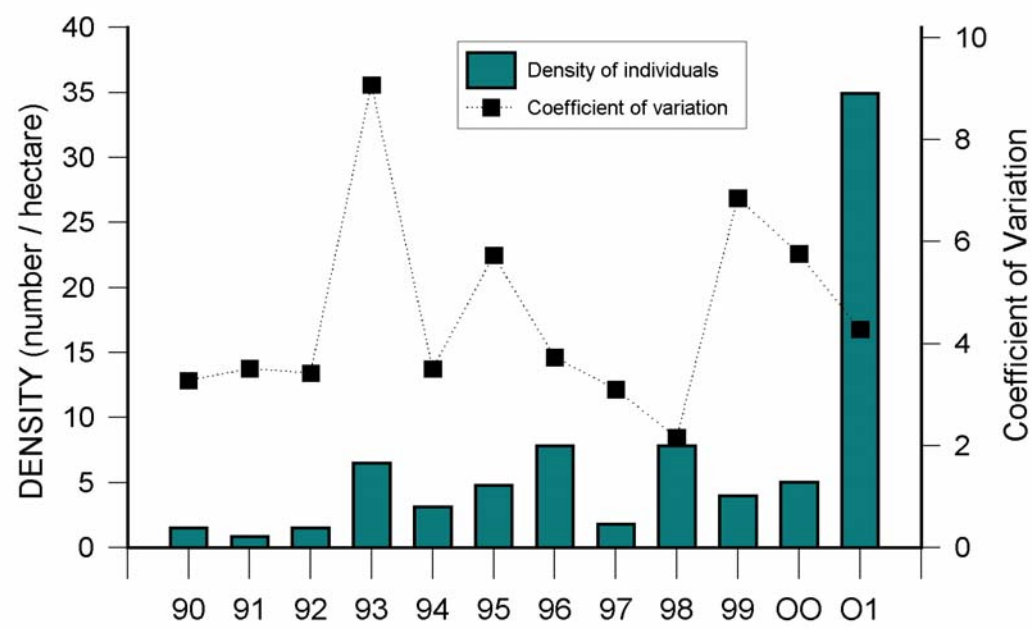

Figure 28. Annual densities of *Peprilus triacanthus*.

Table 19 . Estimates of density (number of individuals/hectare) in 2001.

Peprilus triacanthus

	Spring	Summer	Fall	Region
Raleigh Bay	321.5	2.2	0.1	111.5
Onslow Bay	293.2	9.2	0.4	101.9
Long Bay	10.6	6.1	0.9	6.1
South Carolina	46.2	6.3	0.2	18.2
Georgia	17.9	4.4	0.2	8.0
Florida	1.3	18.4	0.2	3.7
Season	94.0	8.1	0.3	34.9

Total lengths of *Peprilus triacanthus* ranged from 2 to 18 cm ($\bar{x}$ = 9.2). Length was significantly different among seasons (X^2 = 3277, $p < 0.0001$). Mean length decreased from spring to fall (Figure 29). Mean length also varied significantly among regions (X^2 = 2797, $p < 0.0001$). Mean lengths of butterfish were greatest in collections from waters off Florida (Figure 30).

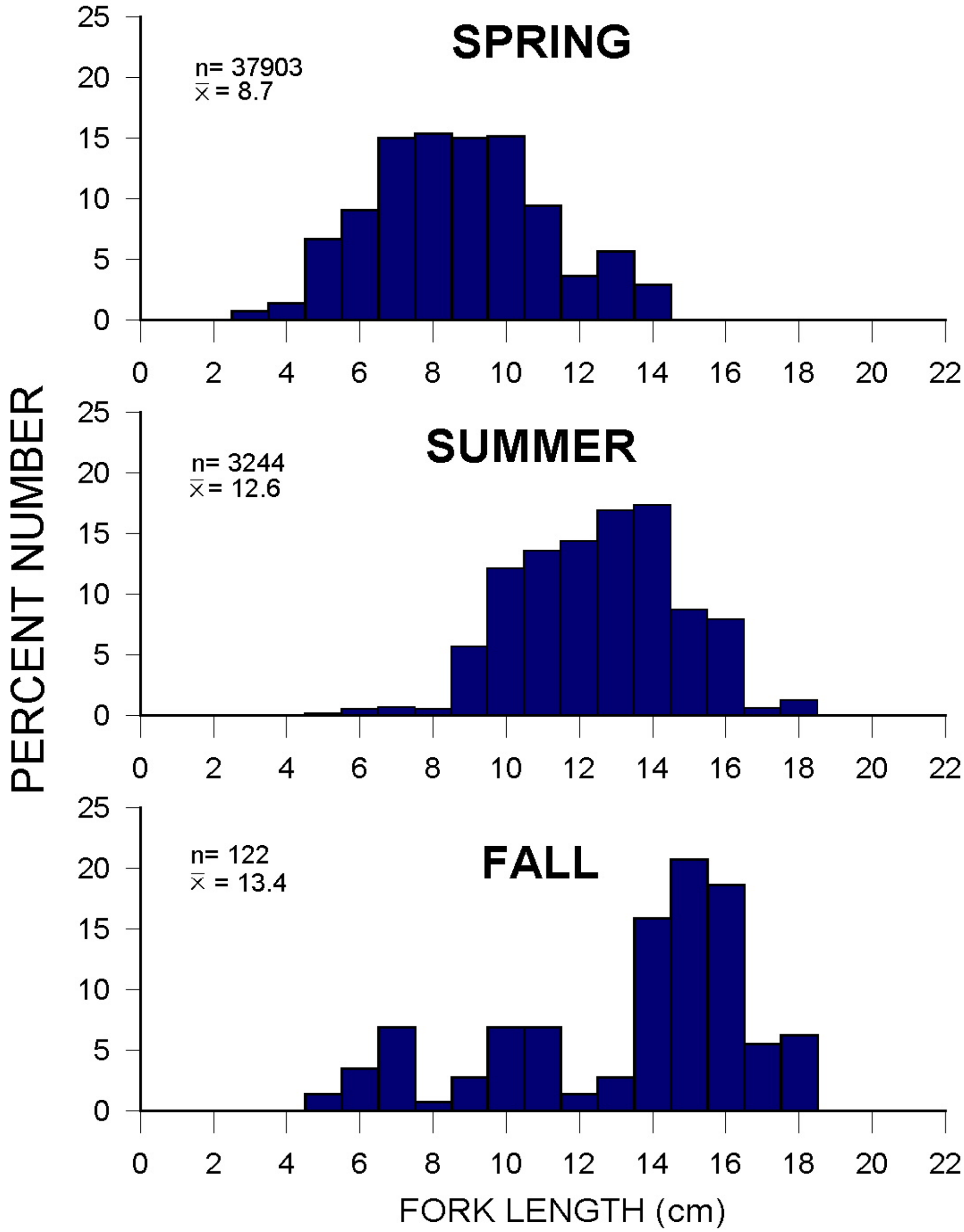

Figure 29. Seasonal length-frequencies of *Peprilus triacanthus* in 2001.

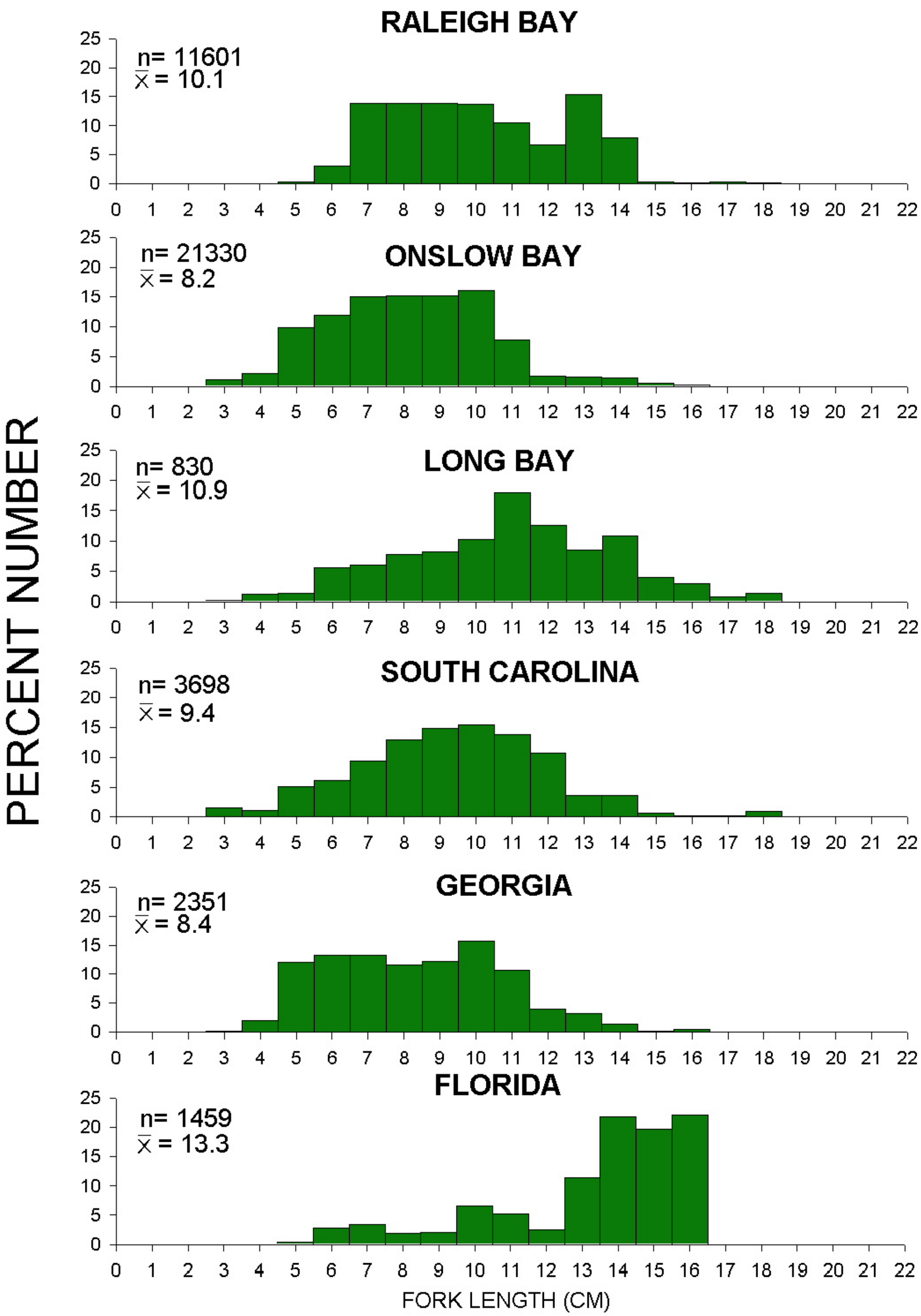

Figure 30. Regional length-frequencies of *Peprilus triacanthus* in 2001.

Pogonias cromis

Black drum extend along the western Atlantic coast from the Gulf of Maine to South Florida and the Lesser Antilles to Guyana, and from Guyana to Rio Grande, Brazil (Chao, 1978). They occur in the Gulf of Mexico from South Florida to a little south of Brownsville Texas along the Mexican coast, and also along the Caribbean side of Cuba. Black Drum is a bottom feeding species found over sand and sandy mud bottoms that is abundant along beaches and large river runoffs. Juveniles can be found in estuaries.

The black drum, *Pogonias cromis*, has been a rare species in SEAMAP-SA collections (SEAMAP-SA/SCMRD, 2000). No black drum were collected in 2001 (Figure 31).

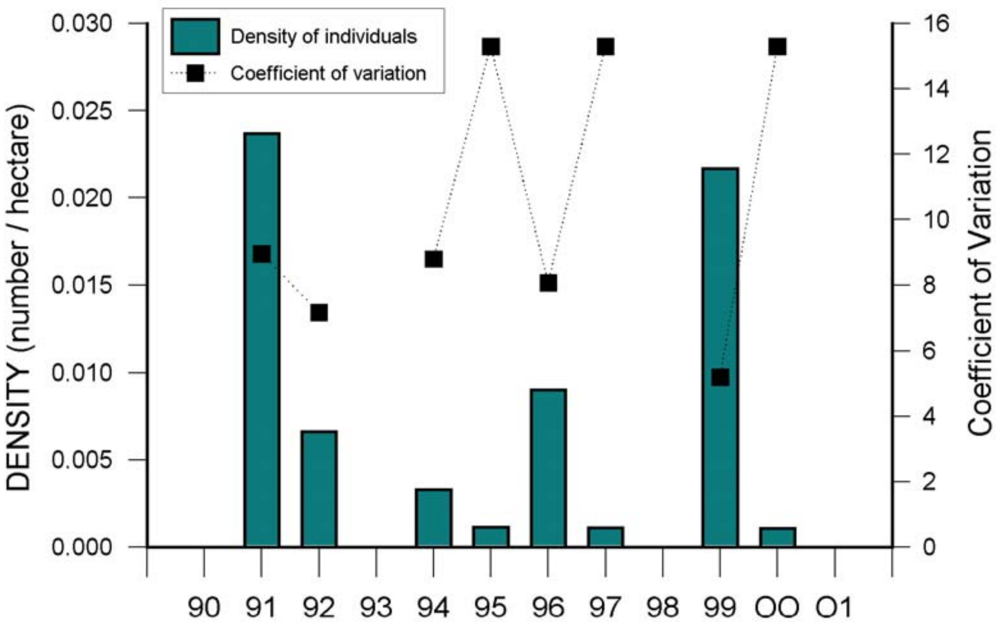

Figure 31. Annual densities of *Pogonias cromis*.

Pomatomus saltatrix

The bluefish is a schooling pelagic fish found in the eastern Atlantic from Nova Scotia throughout the Gulf of Mexico including northern Cuba, along the South American coast from Colombia to Argentina. It also occurs in the eastern Atlantic, the Mediterranean and the Indo-west Pacific (Collette, 1978). Bluefish are important for recreation and food and are the target of a large commercial fishery.

SEAMAP-SA strata yielded a total of 1257 bluefish (CV=3.1; 1.1 individuals/ha) weighing 134 kg (0.1 kg/ha). Density was found to be at the highest level in the history of the SEAMAP-SA project in 1995 (Figure 32). In 2001, density was greatest in fall (Table 20). Bluefish were most abundant in the northern portion of the SAB, with density of individuals decreasing with decreasing latitude.

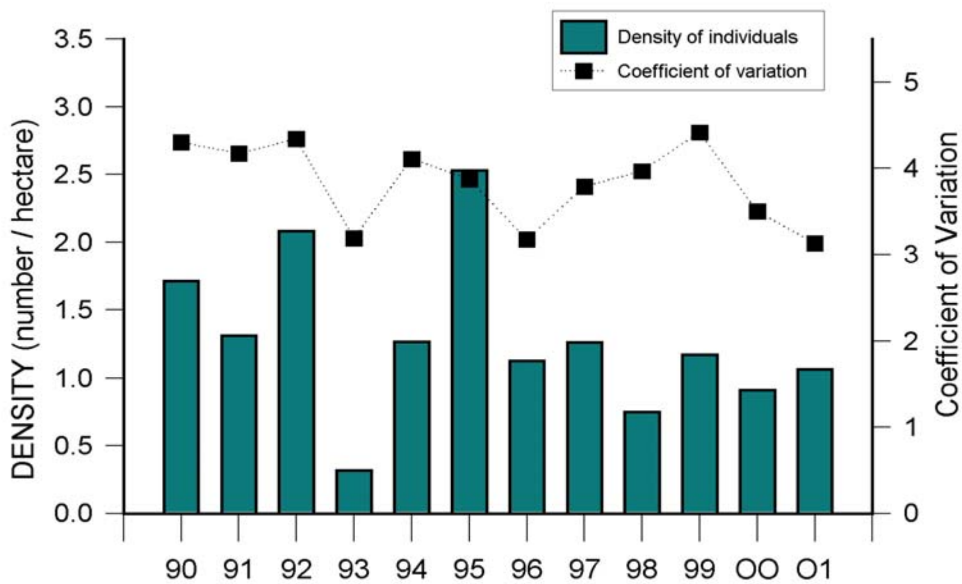

Figure 32. Annual densities of *Pomatomus saltatrix*.

Table 20 . Estimates of density (number of individuals/hectare) in 2001.

Pomatomus saltatrix

	Spring	Summer	Fall	Region
Raleigh Bay	4.4	0.05	6.5	3.3
Onslow Bay	1.3	2.4	1.1	1.6
Long Bay	0.3	1.7	1.0	1.0
South Carolina	0.5	0.7	2.3	1.1
Georgia	0.4	0.4	0.7	0.5
Florida	0.1	0.6	0.03	0.2
Season	0.8	1.0	1.4	1.1

Total lengths of *Pomatomus saltatrix* ranged from 6 to 38 cm ($\bar{x}$ = 20.3). Length was significantly different among seasons (X^2 =94, $p < 0.0001$). Mean length decreased from spring to summer, due to increased recruitment of YOY, and increased in fall, an indication of result of juvenile growth (Figure 33). Mean length also varied significantly among regions (X^2 =73, $p < 0.0001$), with larger fish occurring in the southern portion of the SAB (Figure 34). Mean lengths of bluefish were greatest in collections from waters off South Carolina, Georgia, and Florida.

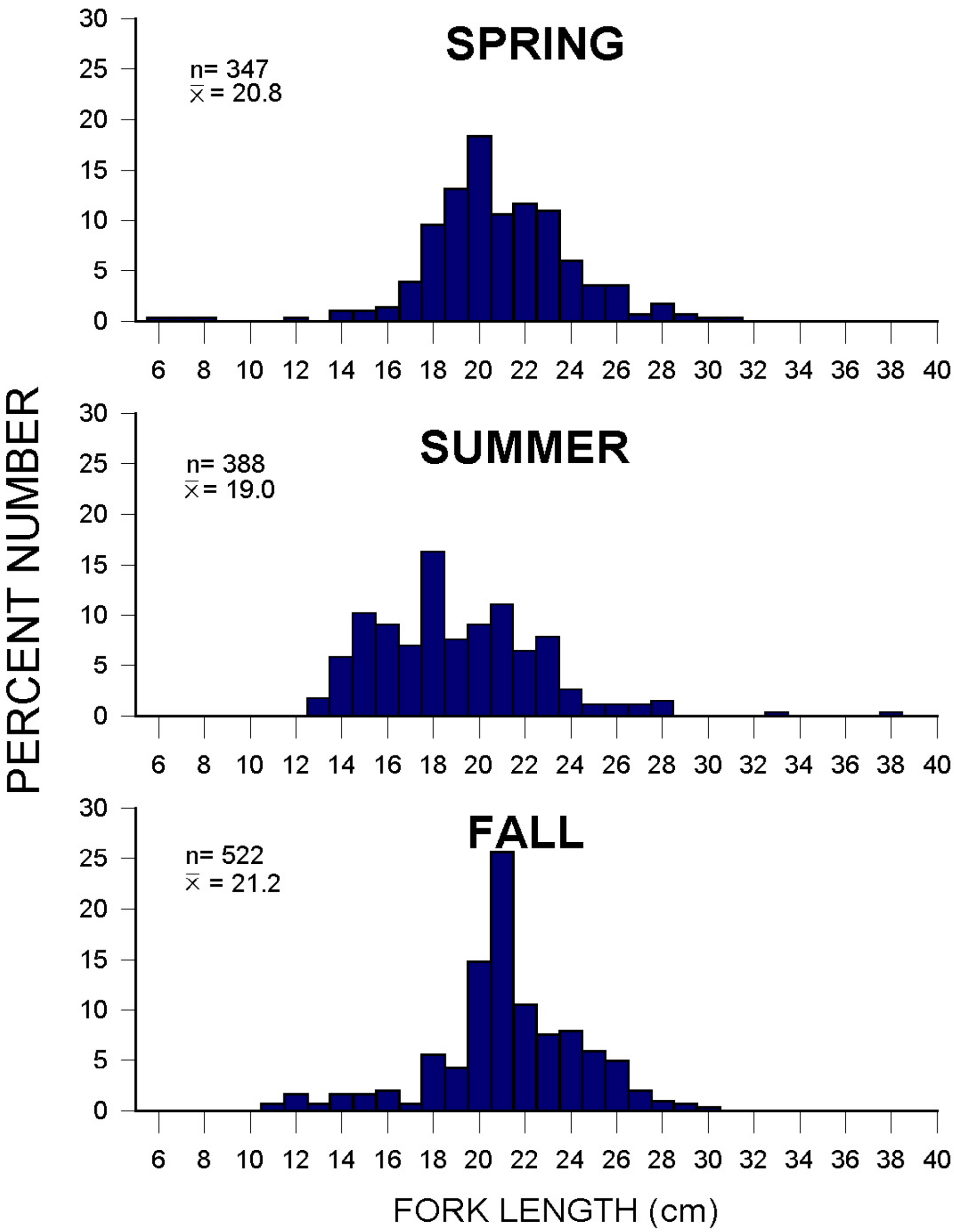

Figure 33. Seasonal length-frequencies of *Pomatomus saltatrix* in 2001.

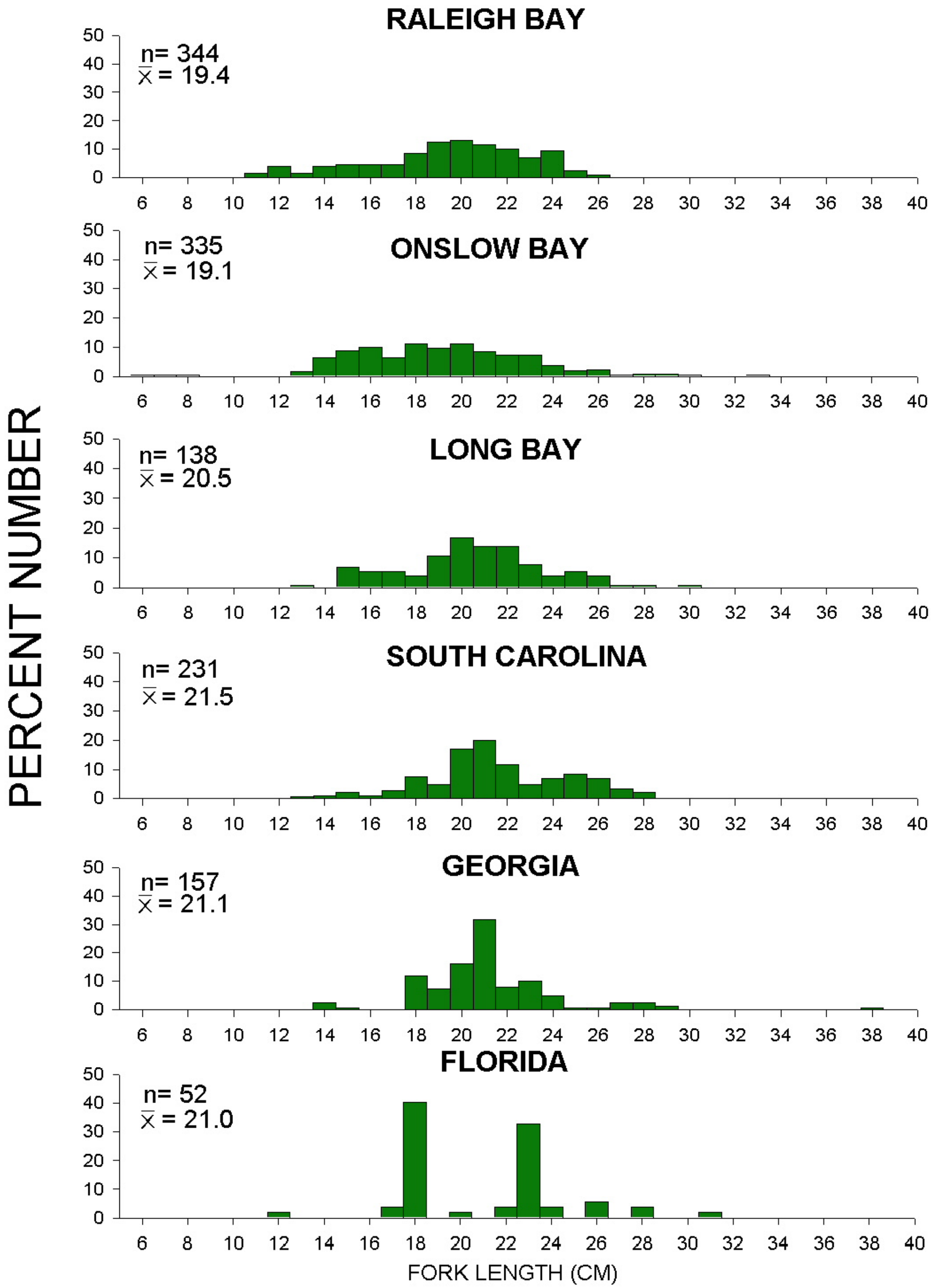

Figure 34. Regional length-frequencies of *Pomatomus saltatrix* in 2001.

Sciaenops ocellatus

Red drum are found along the western Atlantic coast from New York to Florida and in the Gulf of Mexico from South Florida to Laguna Madre, with a distinct population suspected to be living in the Indian River (Chao, 1978). Red drum are found over sand and mud bottoms in coastal waters where it is abundant in estuaries and the surf zone, but can also be found feeding and sheltering in the salt marsh grass at high tide.

The red drum has been a very rare species in SEAMAP-SA trawls (SEAMAP-SA/SCMRD, 2000). In 2001, only 1 individual, measuring 100 cm in length, was taken in spring collections off Georgia.

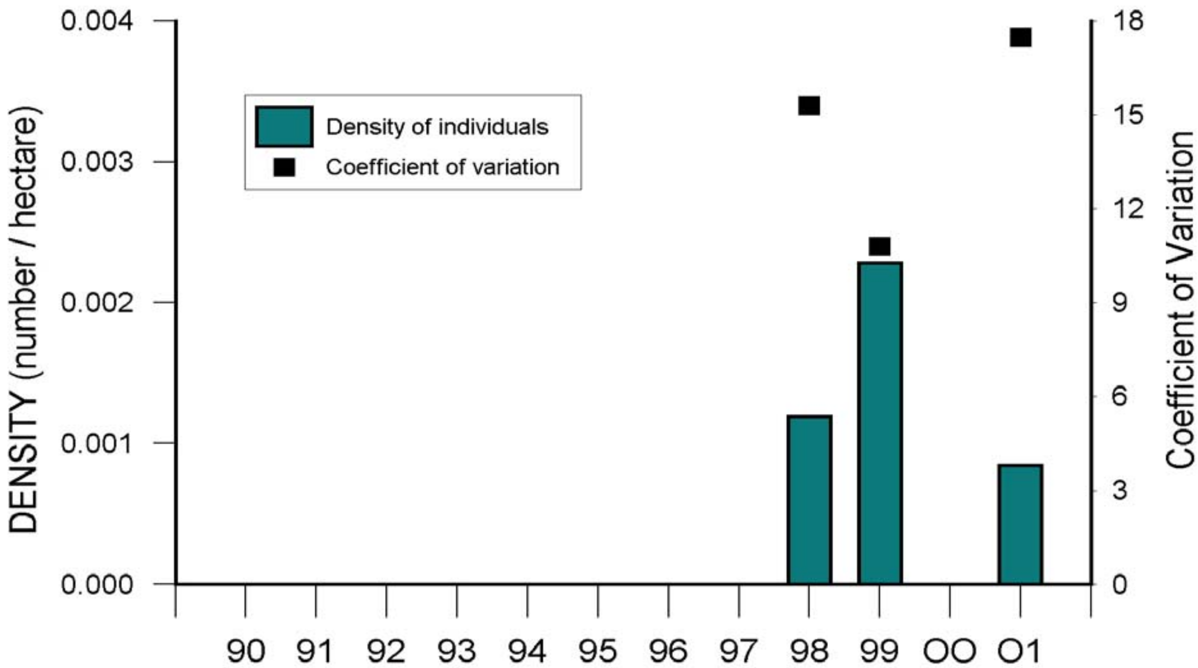

Figure 35. Annual densities of *Sciaenops ocellatus*.

Scomberomorus cavalla

The king mackerel inhabits Atlantic coastal waters from Massachusetts south throughout the Gulf of Mexico and the Caribbean to Rio de Janeiro (Collette, 1978), possibly extending as far north as Maine (Fritzsche, 1978; Berrien and Finan, 1977). Atlantic stocks of king mackerel migrate northward from Florida during the warmer spring and summer months and return south as the waters get colder (Berrien and Finan, 1977), occurring singly or in small groups (Collette, 1978). Commercially, this species is the target of large purse-seine, gill-net, and hook-and-line fisheries (Collette, 1978). King mackerel spawn from May through September, with a peak in spawning activity in July (Finucane et al., 1986).

The 482 (CV=6.0; 0.4 individuals/ha) king mackerel collected from SEAMAP strata in 2001weighed 22 kg (0.02 kg/ha). The density of king mackerel peaked in 1996 and again in 1998 (Figure 36). In 2001, density was greatest in fall (Table 21). King mackerel tend to be most abundant in fall in the southern SAB (SEAMAP-SA/SCMRD, 2000). However, in 2001greatest density of king mackerel occurred in Onslow Bay.

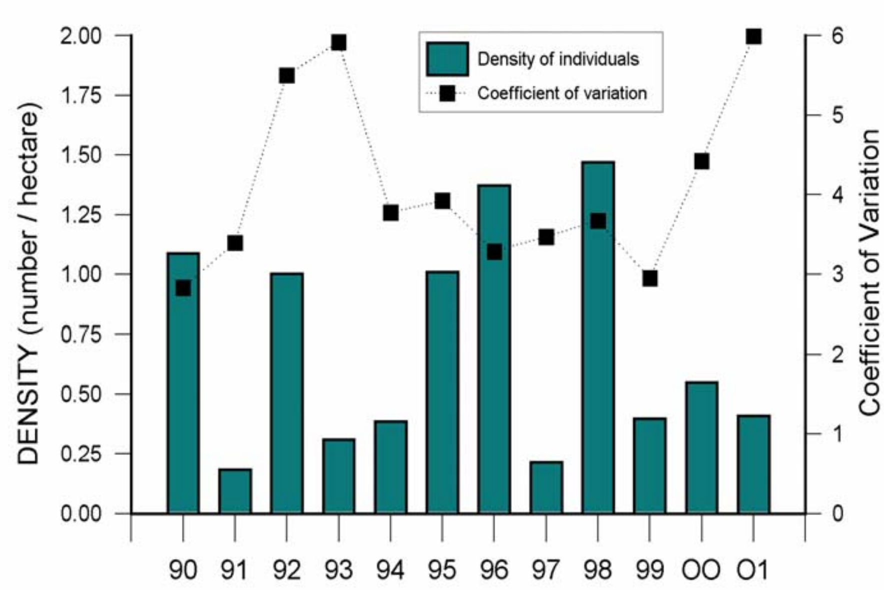

Figure 36. Annual densities of *Scomberomorus cavalla*.

Table 21 . Estimates of density (number of individuals/hectare) in 2001.

Scomberomorus cavalla

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0.04	0.01
Onslow Bay	0	0.3	3.1	1.1
Long Bay	0	0.04	0.07	0.04
South Carolina	0.2	0.07	1.1	0.4
Georgia	0	0.03	0.3	0.1
Florida	0.03	0.7	1.0	0.6
Season	0.04	0.2	1.0	0.4

Fork lengths of *Scomberomorus cavalla* ranged from 4 to 101 cm ($\bar{x}$ = 12.5) and represented two year-classes. Annual cohorts of king mackerel are spawned in spring and summer (Finucane et al., 1986) and reach mean lengths greater than 40 cm by the end of their first year (Collins et al., 1989). Lengths were significantly different among seasons (X^2 = 59 , $p < 0.0001$) and mean length increased from spring to summer, and decreased from summer to fall, as the result of recruitment of YOY (Figure 37). The fish less than 15 cm and greater than 34 cm in summer suggest that recruitment is beginning and that a few specimens from the Age II year class are still present.

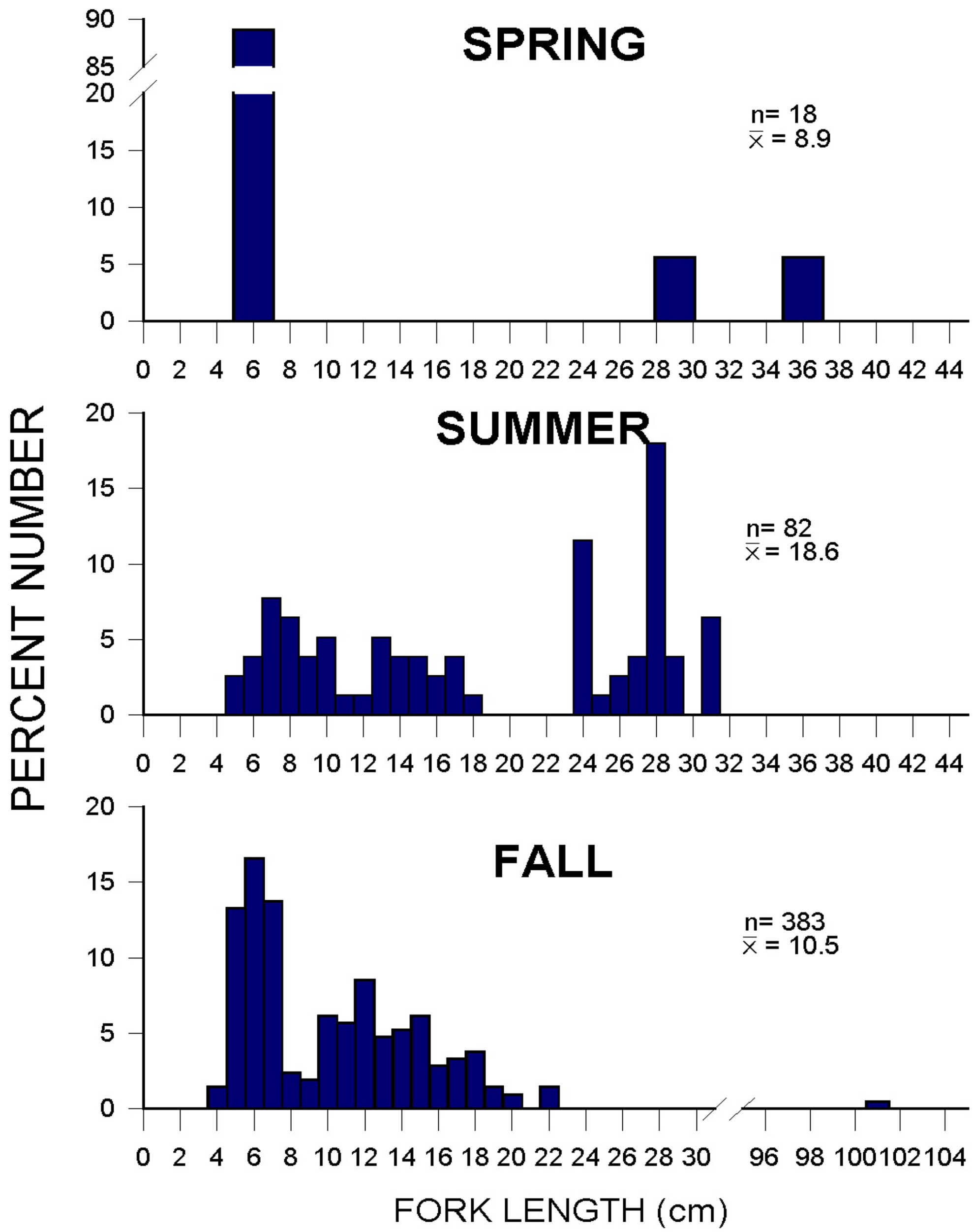

Figure 37. Seasonal length-frequencies of *Scomberomorus cavalla* in 2001.

Lengths varied significantly among regions ($X^2 = 201$, $p < 0.0001$), with Florida waters producing the greatest mean length and mean size decreasing northward (Figure 38). The largest specimen (101 cm) was the only king mackerel caught in the twenty-seven tows made in Raleigh Bay in 2001.

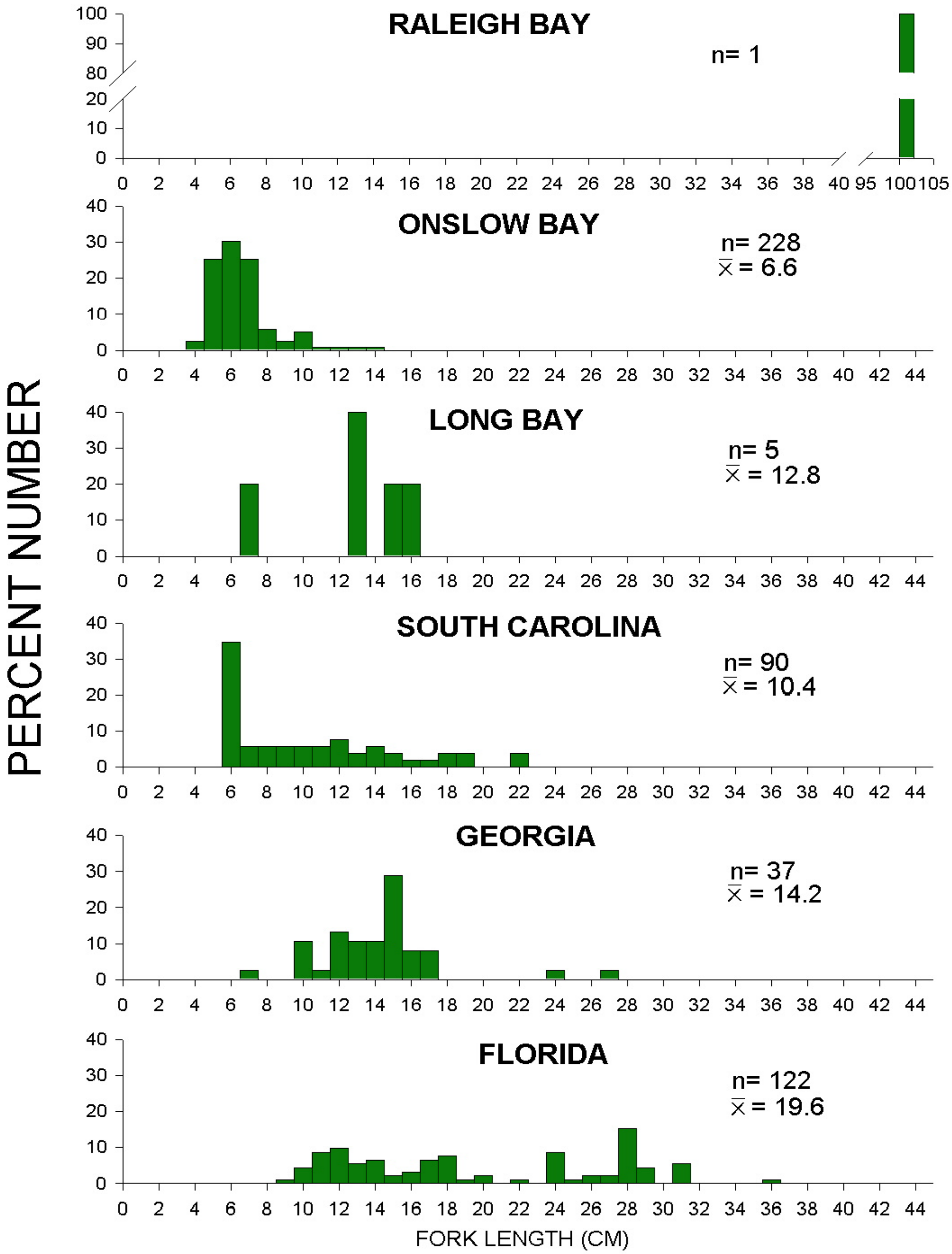

Figure 38. Regional length-frequencies of *Scomberomorus cavalla* in 2001.

Scomberomorus maculatus

Spanish mackerel range from the Gulf of Maine to the Yucatan Peninsula, where they are replaced by *Scomberomorus brasiliensis* from Belize to Brazil (Collette and Russo, 1984). Generally occurring in coastal waters at depths of less than 72 m, S. *maculatus* are known to enter estuaries occasionally (Fritzsche, 1978). An excellent food fish, this species is the target of recreational anglers and supports a large purse-seine and gill-net fishery (Fritzsche, 1978).

Sampling in 2001 produced 2478 Spanish mackerel that weighed a total of 265 kg (CV=4.1; 2.1 individuals/ha; 0.2 kg/ha). The density of individuals of Spanish mackerel in 2001 was exceeded only in 1991 (Figure 39). Highest density of Spanish mackerel is generally found in the southern SAB, off Georgia and Florida (SEAMAP-SA/SCMRD, 2000); however, in 2001 a large number of Spanish mackerel were taken in summer in Onslow Bay (Table 22).

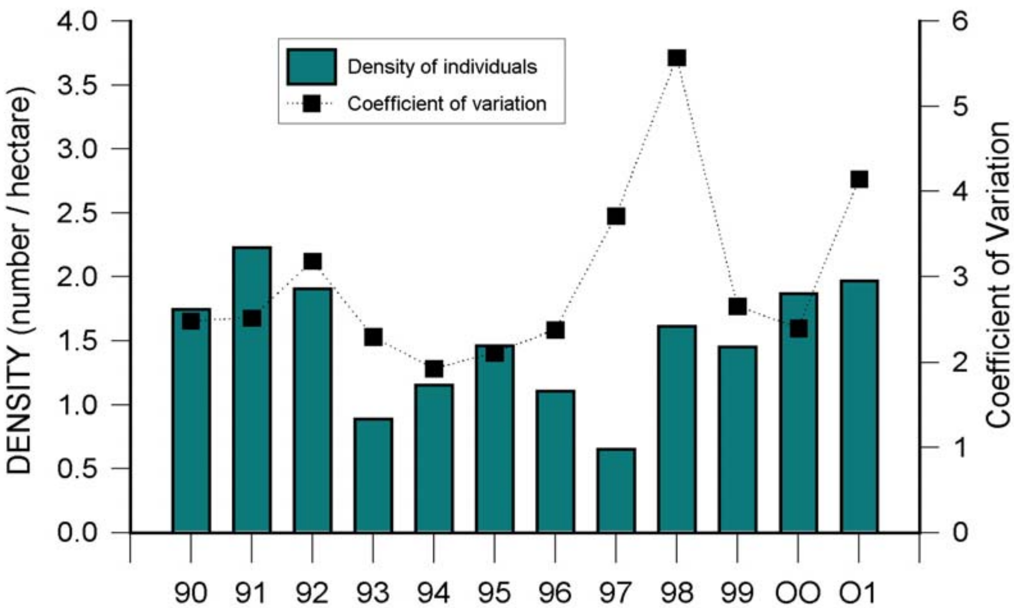

Figure 39. Annual densities of *Scomberomorus maculatus*.

Table 22. Estimates of density (number of individuals/hectare) in 2001.

Scomberomorus maculatus

	Spring	Summer	Fall	Region
Raleigh Bay	0	1.2	0	0.4
Onslow Bay	1.1	15.1	0.1	5.3
Long Bay	0.4	2.5	0.3	1.1
South Carolina	0.1	4.4	0.2	1.6
Georgia	1.2	1.8	0.4	1.2
Florida	3.0	1.2	0.8	1.7
Season	1.0	4.6	0.3	2.0

Fork lengths of Spanish mackerel ranged from 5 to 49 cm ($\bar{x}$ = 22.7 cm). Lengths differed significantly among seasons ($X^2 = 581$, $p < 0.0001$). Mean length decreased from spring to fall, indicating the recruitment of YOY individuals throughout the year (Figure 40). By the end of their first year, Spanish mackerel reach lengths greater than 30 cm (Powell, 1975). Specimens collected in spring were generally fish ending their first year. Summer collections contained primarily newly recruited YOY with a few representatives of the previous year-class still present. Fall collections were made up of fish from two year-classes. Length also varied significantly among regions ($X^2 = 125$, $p < 0.0001$), and mean lengths ranged from a low of 19.4 cm in waters off South Carolina to 24.7 cm off Florida (Figure 41).

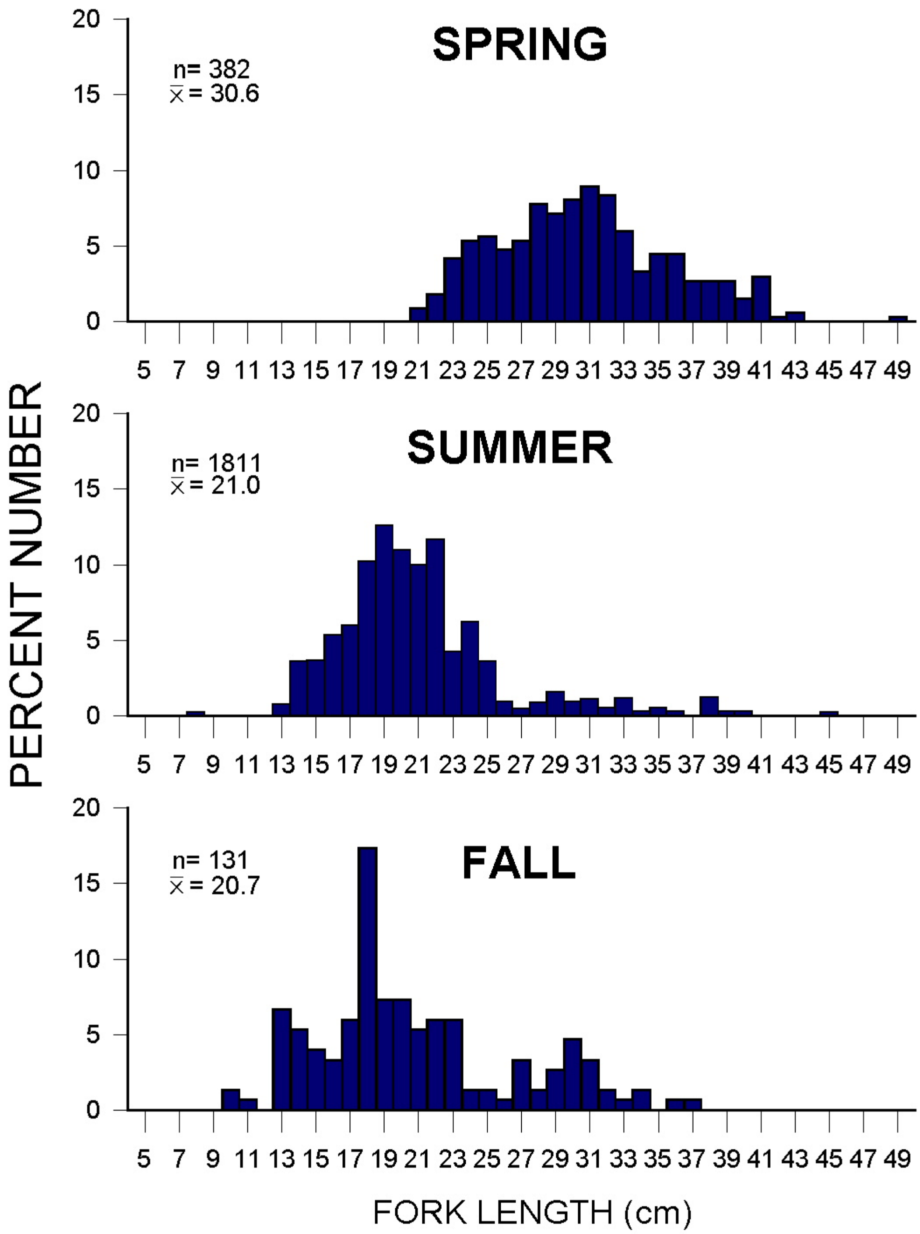

Figure 40. Seasonal length-frequencies of *Scomberomorus maculatus* in 2001.

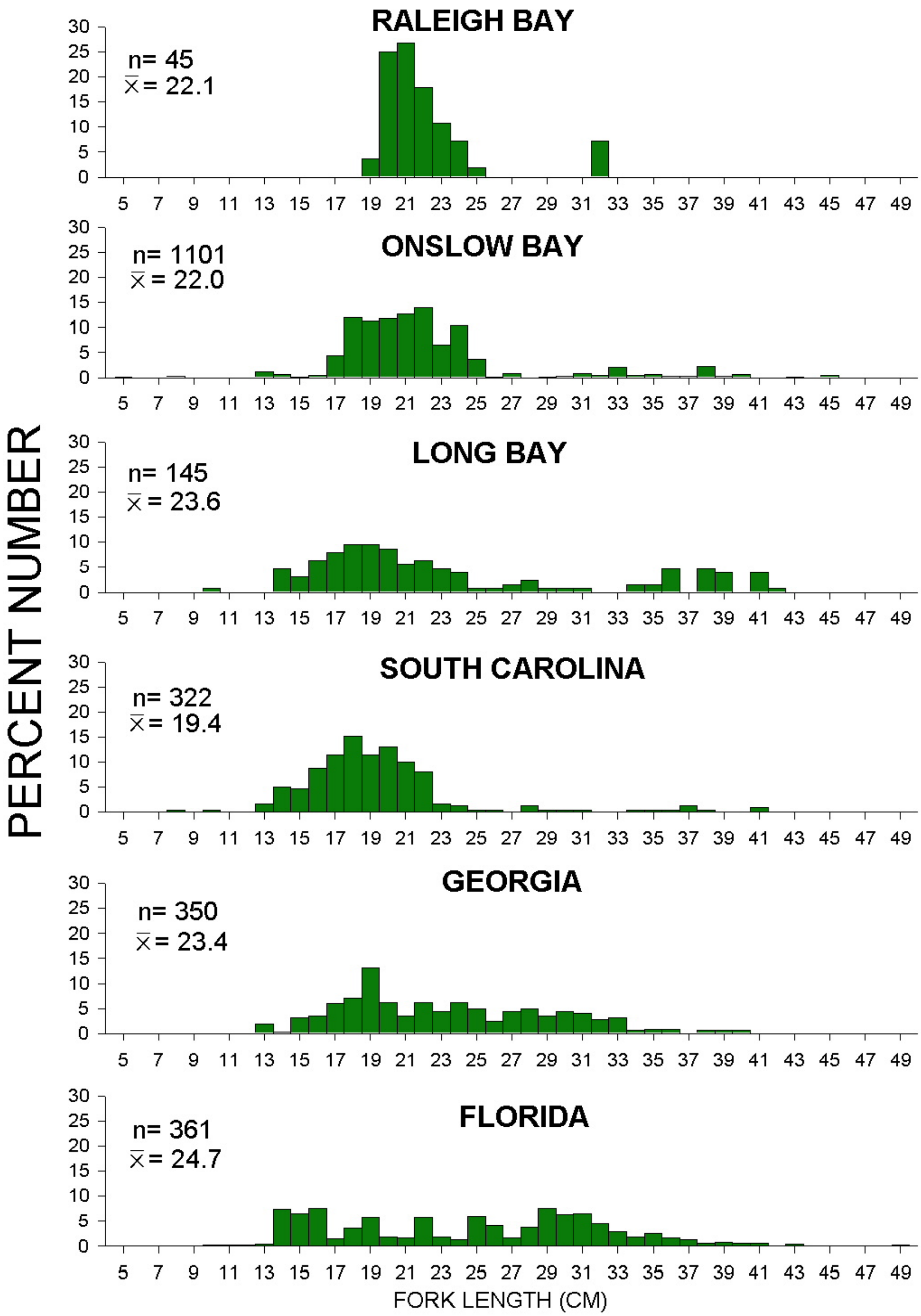

Figure 41. Regional length-frequencies of *Scomberomorus maculatus* in 2001.

Callinectes sapidus

Ranging from Nova Scotia to northern Argentina, *C. sapidus* is an amphi-Atlantic species, with introduced individuals occurring in parts of Europe and the Mediterranean Sea (Williams, 1984). The blue crab is a euryhaline species found in oligohaline, estuarine, and shallow oceanic waters and common on sandy and muddy bottoms. This species supports important commercial and recreational fisheries (Eldridge and Waltz, 1977; Williams, 1984; Low et al., 1987).

SEAMAP strata yielded a total of 291 (CV=9.2; 0.2 individuals/ha) blue crabs weighing 42 kg (0.04 kg/ha) (Table 23). Overall density of *C. sapidus* peaked in 1990, followed by several years of low abundance and a secondary peak in 1999 (Figure 42). The highest seasonal density was observed during summer cruises and the greatest regional density of individuals occurred in Onslow Bay. Carapace widths of *C. sapidus* ranged from 7 to 18 cm ($\bar{x}$ = 13.6).

Males constituted only 1% of the blue crab catch. The tendency of males to inhabit lower salinity estuarine waters explains their lesser importance in offshore catches (Low et al., 1987). Mature female blue crab dominated catches, with over 57% of females being ovigerous. Ovigerous females outnumbered nonovigerous females in all seasons, except fall, and in all regions, except Georgia and Florida, where only two crabs were taken.

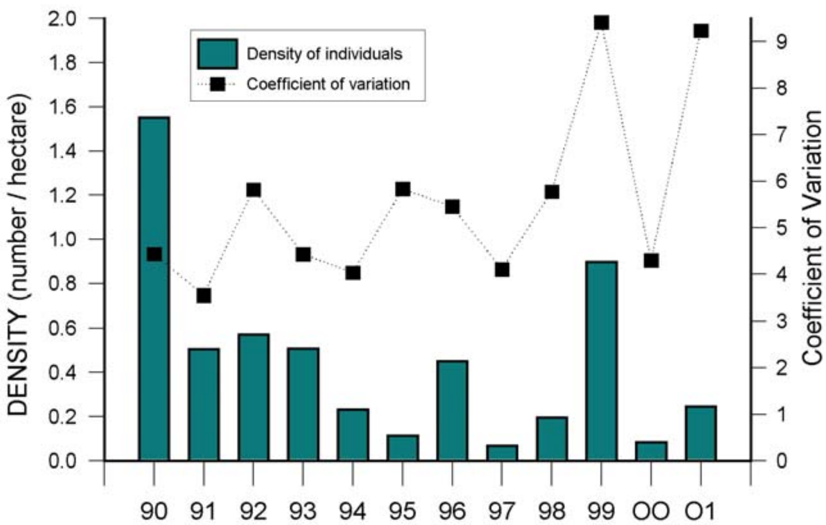

Figure 42. Annual densities of *Callinectes sapidus*.

Table 23 . Estimates of density (number of individuals/hectare) in 2001.

Callinectes sapidus

	Spring	Summer	Fall	Region
Raleigh Bay	0	0.4	0	0.1
Onslow Bay	0.04	3.5	0.3	1.3
Long Bay	0	0.02	0	0.007
South Carolina	0	0.01	0	0.005
Georgia	0.02	0	0	0.007
Florida	0.03	0	0	0.009
Season	0.02	0.7	0.05	0.2

Farfantepenaeus aztecus

Brown shrimp, formerly *Penaeus aztecus* (Perez-Farfante and Kensley, 1997), occur from Martha's Vineyard, Massachusetts, to the Florida Keys and around the Gulf of Mexico to northwestern Yucatan (Perez-Farfante, 1978; Williams, 1984). The spawning of brown shrimp is protracted and the time varies regionally, but generally occurs in fall and winter (Williams, 1984). The species supports a seasonal fishery along the mid-Atlantic states, but is most important commercially in the Gulf of Mexico off the coast of Texas (Perez-Farfante, 1978; South Atlantic Fishery Management Council, 1981; Renfro and Brusher, 1982).

The brown shrimp ranked third among decapod crustaceans, with 10,204 specimens (CV=3.0; 8.6 individuals/ha) collected weighing 188 kg (0.2 kg/ha). The density of brown shrimp in 2001 was exceeded only by estimates from 1996 (Figure 43). Summer collections produced the highest seasonal density (Table 24). The greatest regional density of brown shrimp occurred in Onslow Bays. The overall seasonal pattern of abundance of brown shrimp includes small spring catches, followed by larger summer catches, and moderately-sized fall catches (SEAMAP-SA/SCMRD, 2000).

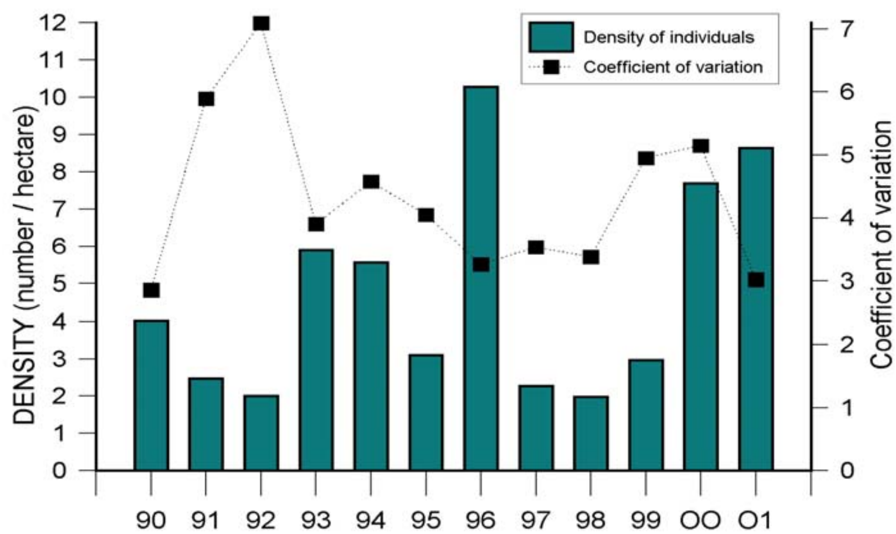

Figure 43. Annual densities of *Farfantepenaeus aztecus*.

Table 24 . Estimates of density (number of individuals/hectare) in 2001.

Farfantepenaeus aztecus

	Spring	Summer	Fall	Region
Raleigh Bay	0	0.7	0.5	0.4
Onslow Bay	1.13	42.8	3.6	15.8
Long Bay	0	20.1	1.6	7.1
South Carolina	0	27.8	6.9	11.5
Georgia	0.01	22.1	2.0	8.4
Florida	0.01	14.2	0.01	4.8
Season	0.01	23.1	2.6	8.6

Total lengths of *F. aztecus* ranged from 8 to 19 cm with a mean length of 12.8 cm. Total lengths differed significantly among seasons ($X^2 = 10$, $p < 0.01$) Mean length increased from spring to summer and decrease from summer to fall, indicating the recruitment of YOY individuals (Figure 44).

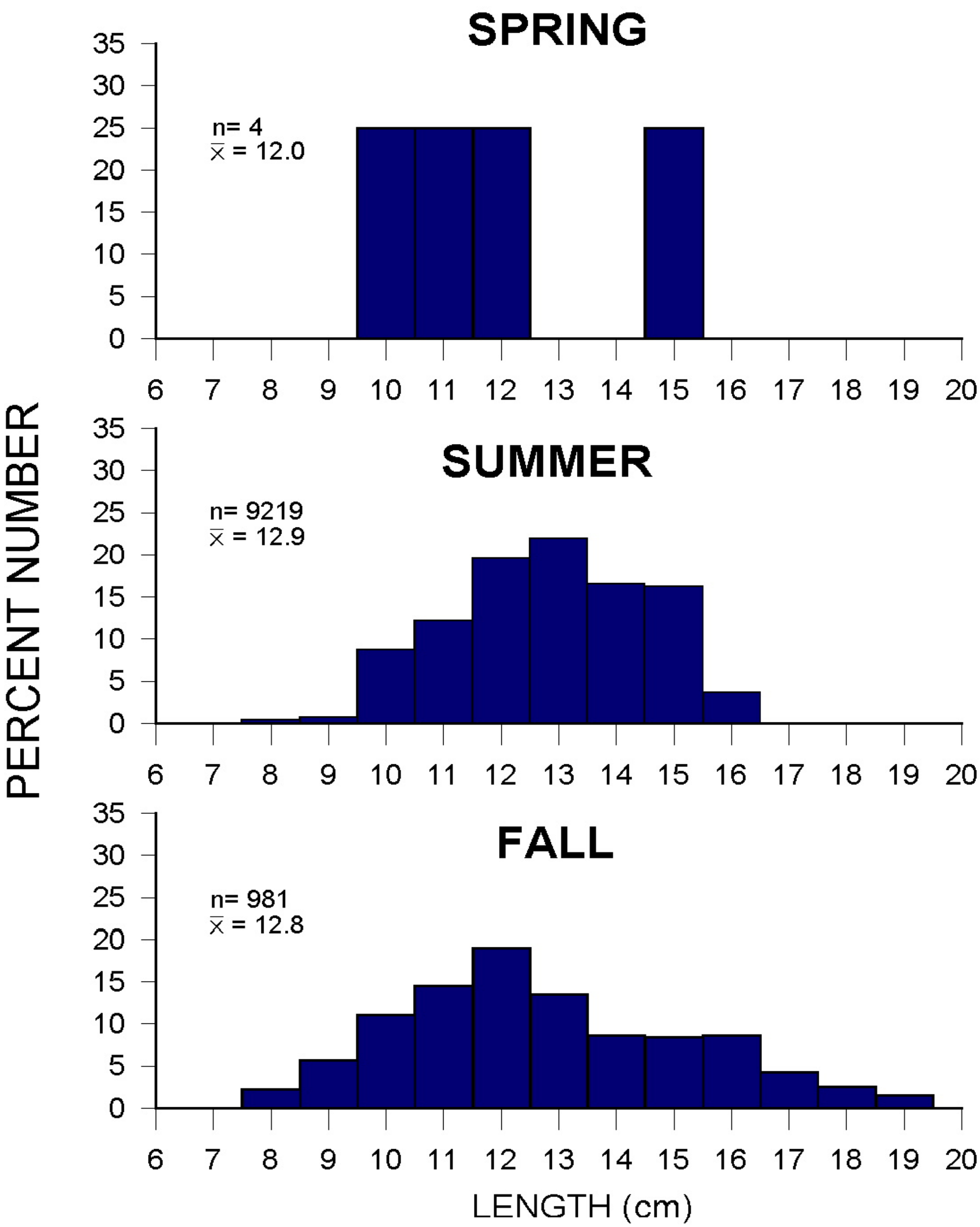

Figure 44. Seasonal length-frequencies of *Farfantepenaeus aztecus* in 2001.

Lengths were also significantly different among regions (X^2 =619, $p < 0.0001$). Mean lengths ranged from 12.2 cm in Long Bay to 1.38 cm in waters of Florida (Figure 45).

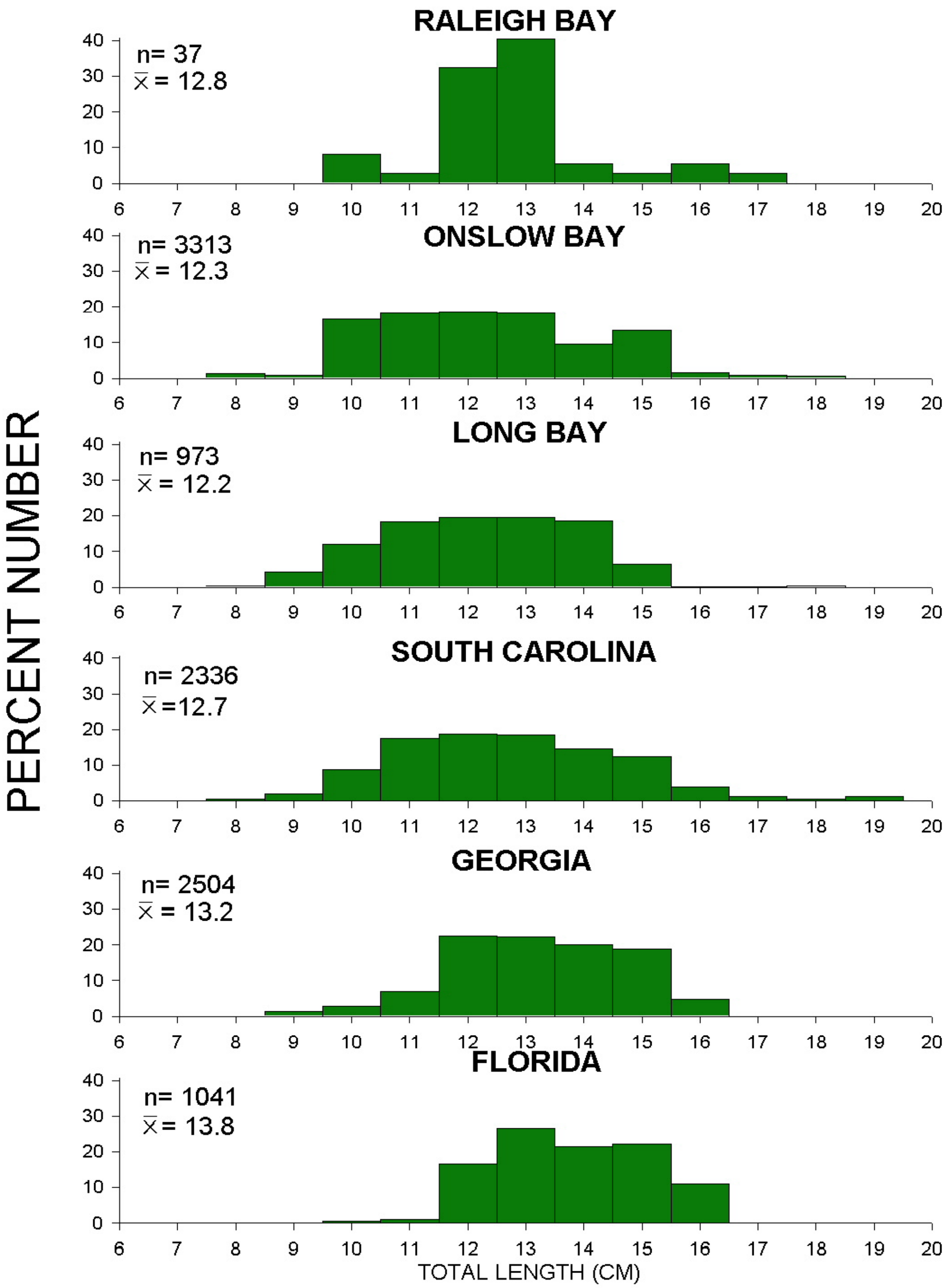

Figure 45. Regional length-frequencies of *Farfantepenaeus aztecus* in 2001.

Less than 3% of the male brown shrimp had fully developed spermatophores (ripe), and less than 1% of the females had ripe ovaries (Figure 46). Spermatophore development was not independent of season (G =282, $p < 0.0001$) or region (G =297, $p < 0.0001$). The percentage of ripe males was greatest in summer Only one female with ripe ovaries was sampled in 2001. Less than 1% of the female brown shrimp were found to be mated.

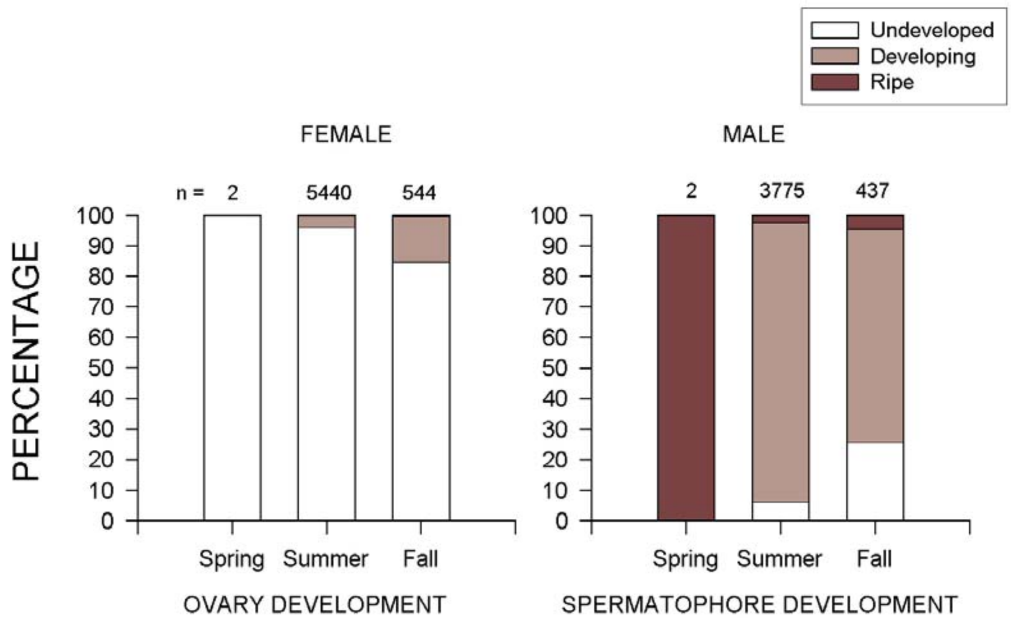

Figure 46. Gonadal development of *Farfantepenaeus aztecus* in 2001.

Farfantepenaeus duorarum

Pink shrimp, formerly *Penaeus duorarum* (Perez-Farfante and Kensley, 1997), are found from Chesapeake Bay to the Florida keys and throughout the Gulf of Mexico to the Yucatan peninsula (Perez-Farfante, 1978; Williams, 1984). They are most abundant in waters off the Gulf coast of Florida, in the Bay of Campeche, and in waters off North Carolina (Perez-Farfante, 1978; Williams, 1984).

The pink shrimp was the least abundant commercially important penaeid shrimp species collected in 2001. The 593 specimens (CV=3.9; 0.5 individuals/ha) taken from SEAMAP weighed 9 kg (0.008 kg/ha). Annual density peaked in 1995 (Figure 47) due to exceptional catches of pink shrimp in Raleigh Bay in spring and summer. In 2001, abundance was greatest in spring collections in Onslow Bay. Regional densities were observed to decrease from Onslow Bay southward (Table 25).

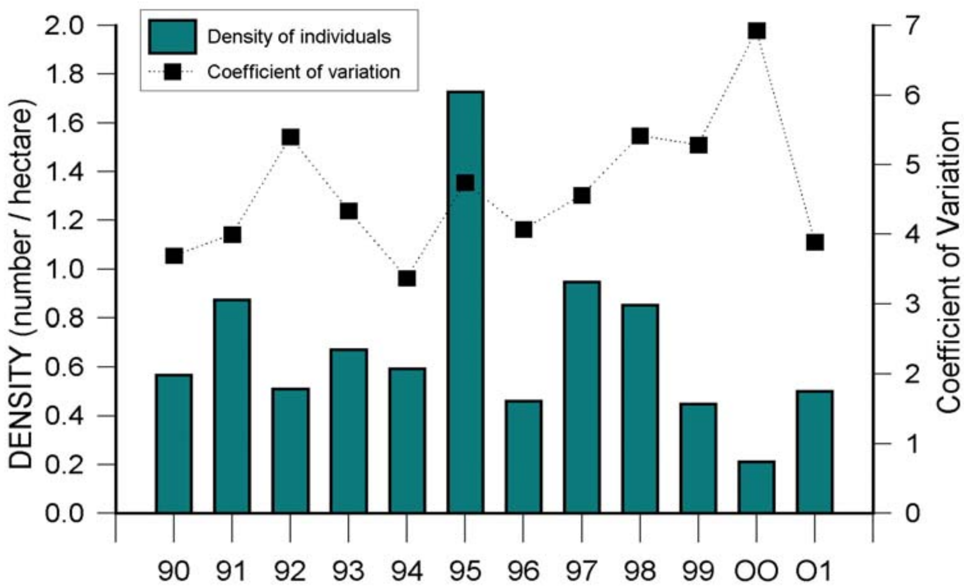

Figure 47. Annual densities of *Farfantepenaeus duorarum*.

Table 25 . Estimates of density (number of individuals/hectare) in 2001.

Farfantepenaeus duorarum

	Spring	Summer	Fall	Region
Raleigh Bay	0.2	0.05	0	0.09
Onslow Bay	3.2	0.02	1.4	1.5
Long Bay	0.6	0	0.6	0.4
South Carolina	0.4	0	1.5	0.6
Georgia	0.6	0.04	0.1	0.3
Florida	0.1	0.01	0	0.04
Season	0.9	0.02	0.6	0.5

Total length of pink shrimp ranged from 7 to 18 cm ($\bar{x}$ =11.9 cm). Total lengths varied significantly among seasons (X^2 =22, $p < 0.0001$). Mean length was greatest in spring (12.2 cm) and decreased in summer (12.0 cm) and fall (11.6 cm) (Figure 48). Total length did differ significantly among regions (X^2 =18, $p < 0.01$). Regionally, mean lengths ranged from 10.4 cm in Florida to 121 cm in Raleigh Bay, Onslow Bay, and Georgia (Figure 49).

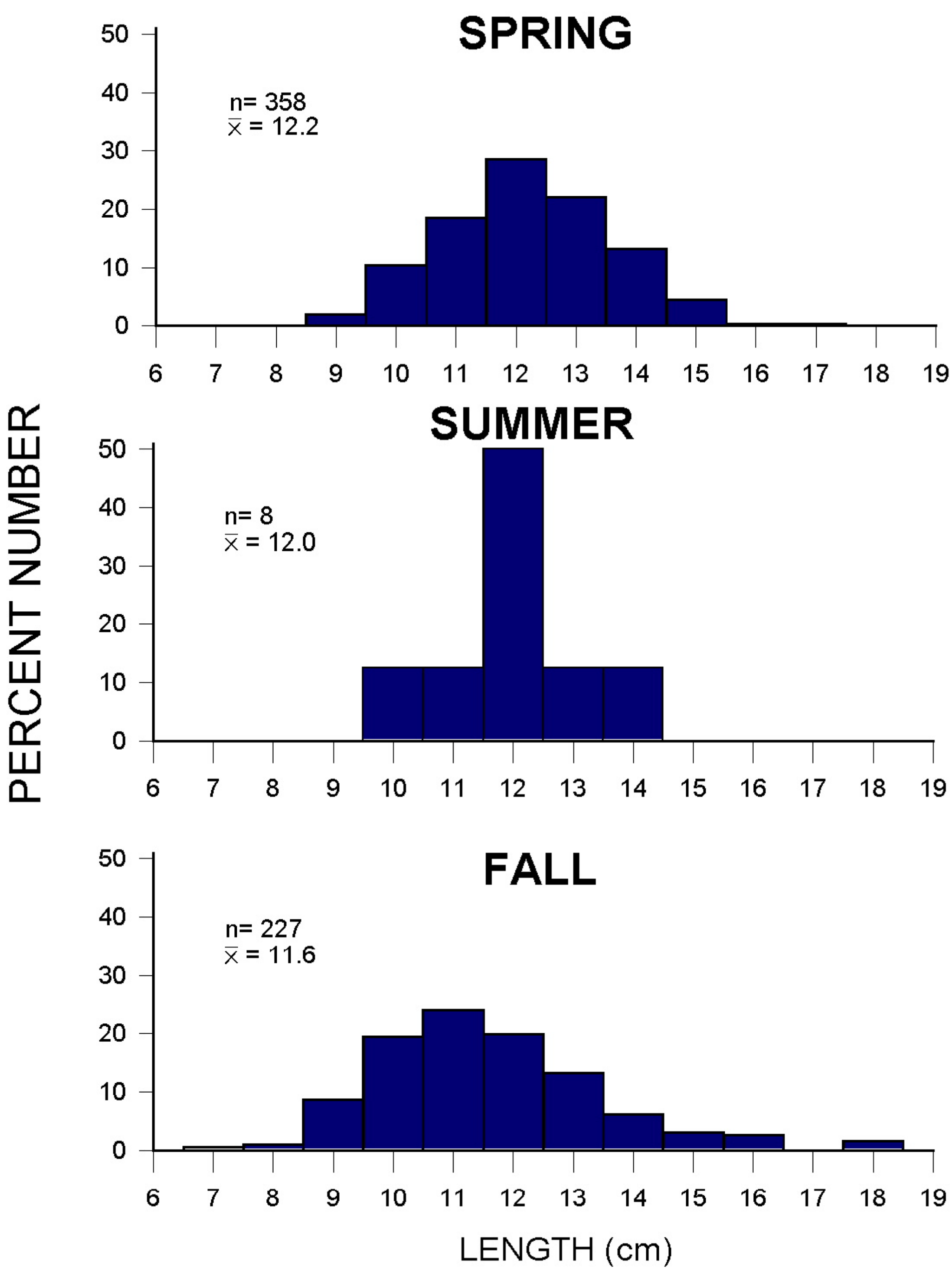

Figure 48. Seasonal length-frequencies of *Farfantepenaeus duorarum* in 2001.

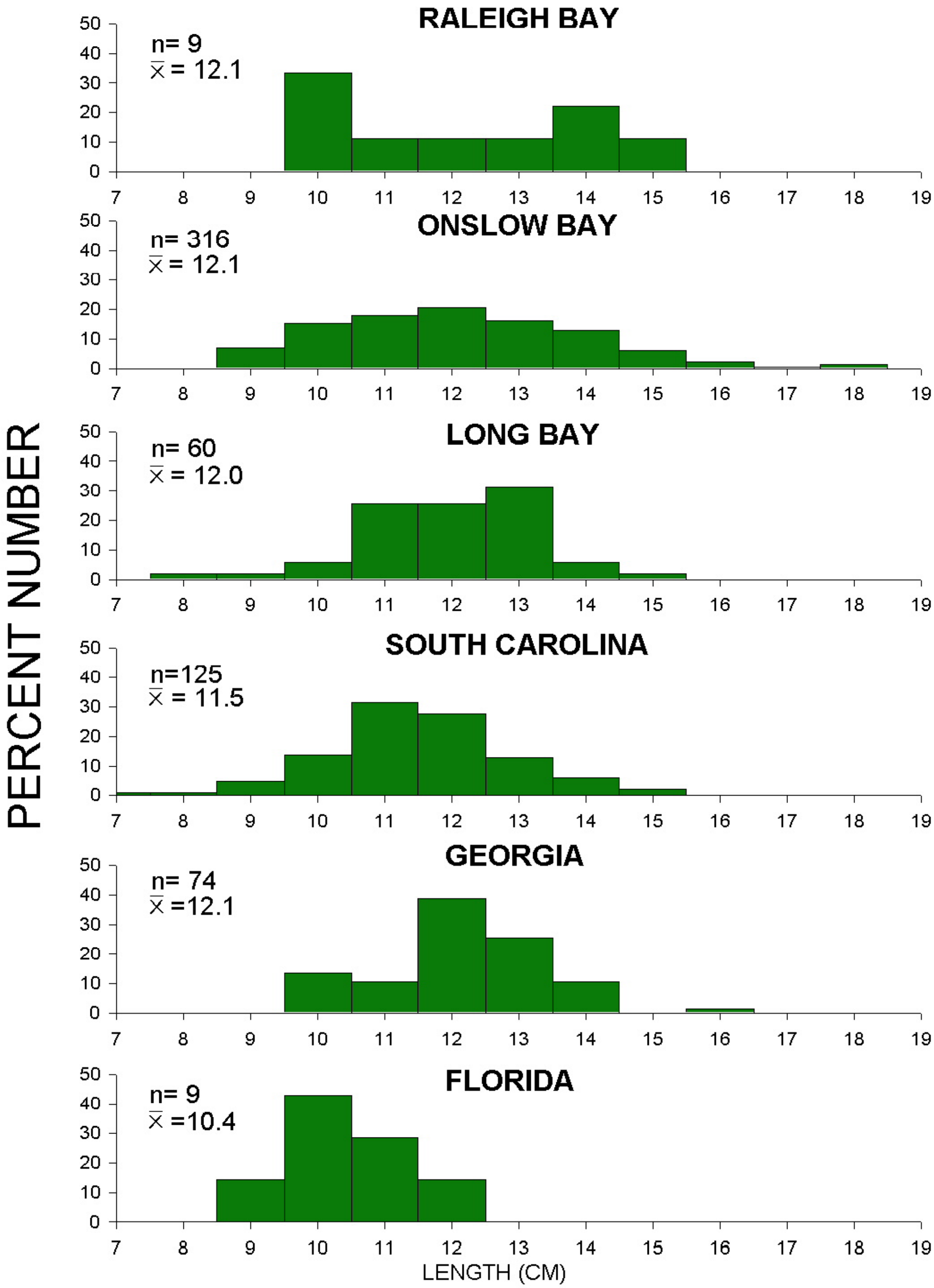

Figure 49. Regional length-frequencies of *Farfantepenaeus duorarum* in 2001.

In SEAMAP strata approximately 35% of male pink shrimp sampled had fully developed spermatophores (Figure 50). Spermatophore development was not independent of season ($G = 88$, $p < 0.0001$) or region ($G = 24$, $p < 0.01$). Burukovskii and Bulanenkov (1971) reported that spawning activity of pink shrimp in North Carolina waters peaked in spring. No ripe female pink shrimp were collected in 2001; however, approximately 6% of the total number of female pink shrimp sampled were mated. Like brown shrimp, copulation in pink shrimp may occur regardless of developmental stage of the ovaries (Perez-Farfante, 1969).

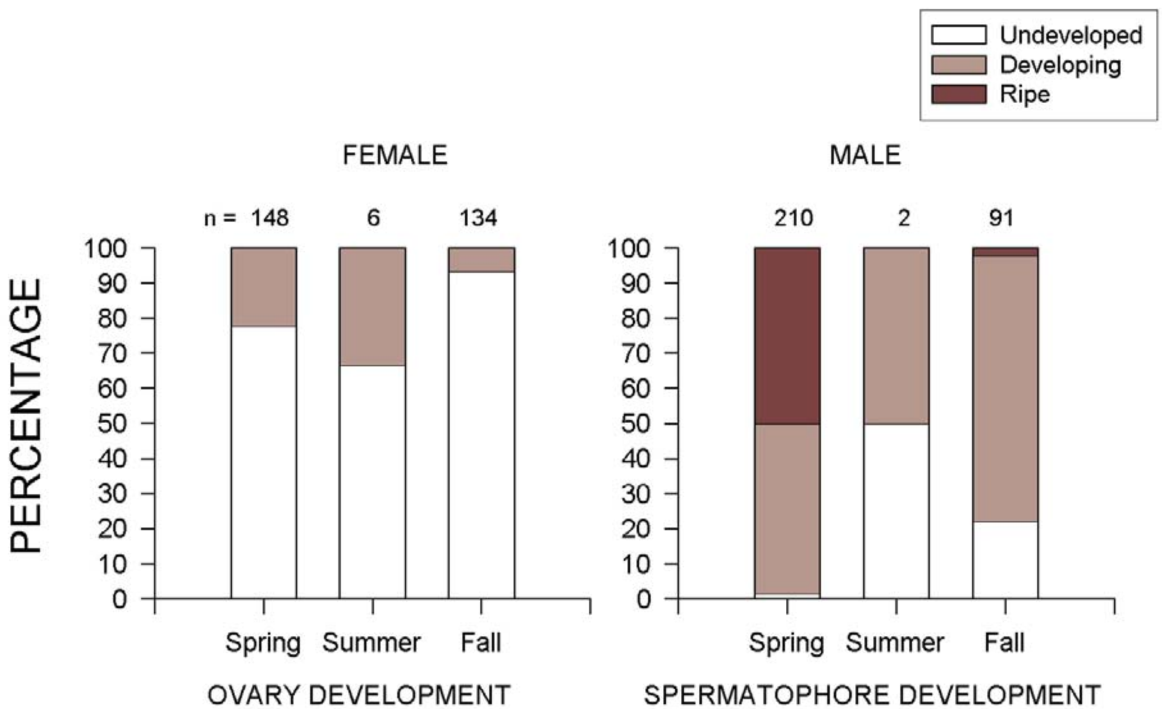

Figure 50. Gonadal development of *Farfantepenaeus duorarum* in 2001.

The geographical range of white shrimp, formerly *Penaeus setiferus* (Perez-Farfante and Kensley, 1997), extends from New York to southern Florida and throughout the Gulf of Mexico (Perez-Farfante, 1978; Williams, 1984). White shrimp spawning in the SAB begins in May and continues into September (Lindner and Anderson, 1956; Williams, 1984). Centers of abundance along the Atlantic coast of the United States are found in waters off northeastern Florida, Georgia, and South Carolina (Perez-Farfante, 1978; Williams, 1984), where the species supports a large commercial fishery (South Atlantic Fishery Management Council, 1981).

White shrimp was the most abundant commercially important decapod crustacean species from strata in the SEAMAP-SA Trawl Survey and ranked tenth in abundance overall, with 12,351 (CV=5.2; 10.5 individuals/ha) weighing 305 kg (0.3 kg/ha). The annual density of abundance of *L. setiferus* in 1999 was the greatest annual density in the history of the survey (Figure 51). Density was highest in fall collections (Table 26). Greatest regional densities of abundance were found in Onslow Bay and off Georgia.

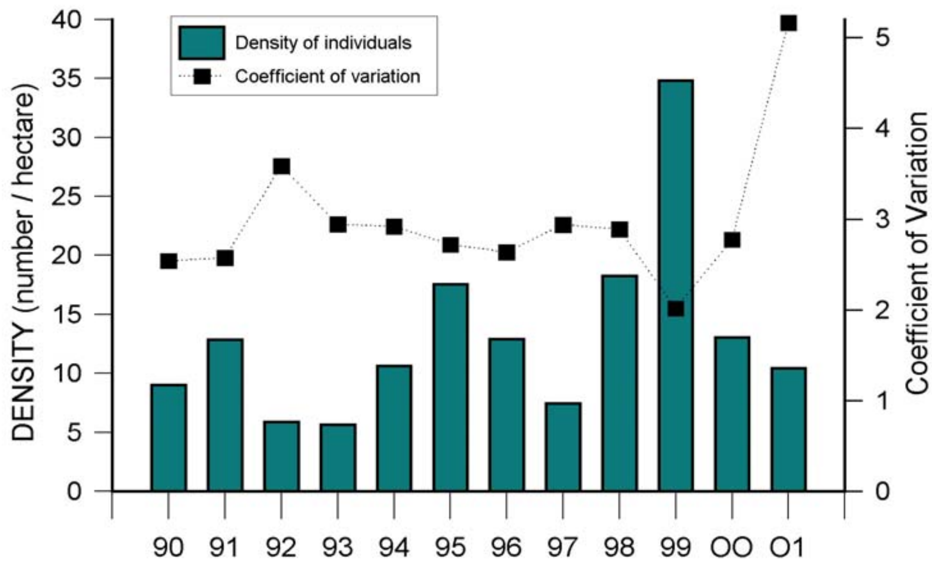

Figure 51. Annual densities of *Litopenaeus setiferus*.

Table 26 . Estimates of density (number of individuals/hectare) in 2001.

Litopenaeus setiferus

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0.3	0.07
Onslow Bay	0.09	0.1	59.4	19.1
Long Bay	0.1	0.07	3.0	1.0
South Carolina	0.1	0.1	22.0	7.1
Georgia	3.3	1.4	38.5	15.1
Florida	0.8	9.1	22.5	10.6
Season	1.0	2.1	29.2	10.5

Total lengths of *L. setiferus* ranged from 8 to 19 cm, with a mean length of 14.7 cm. There was a significant difference in mean length among seasons ($X^2 = 25$, $p < 0.0001$) (Figure 52), with mean length greatest in spring. Smaller YOY individuals began moving out of the estuaries in summer and continued to do so into the fall

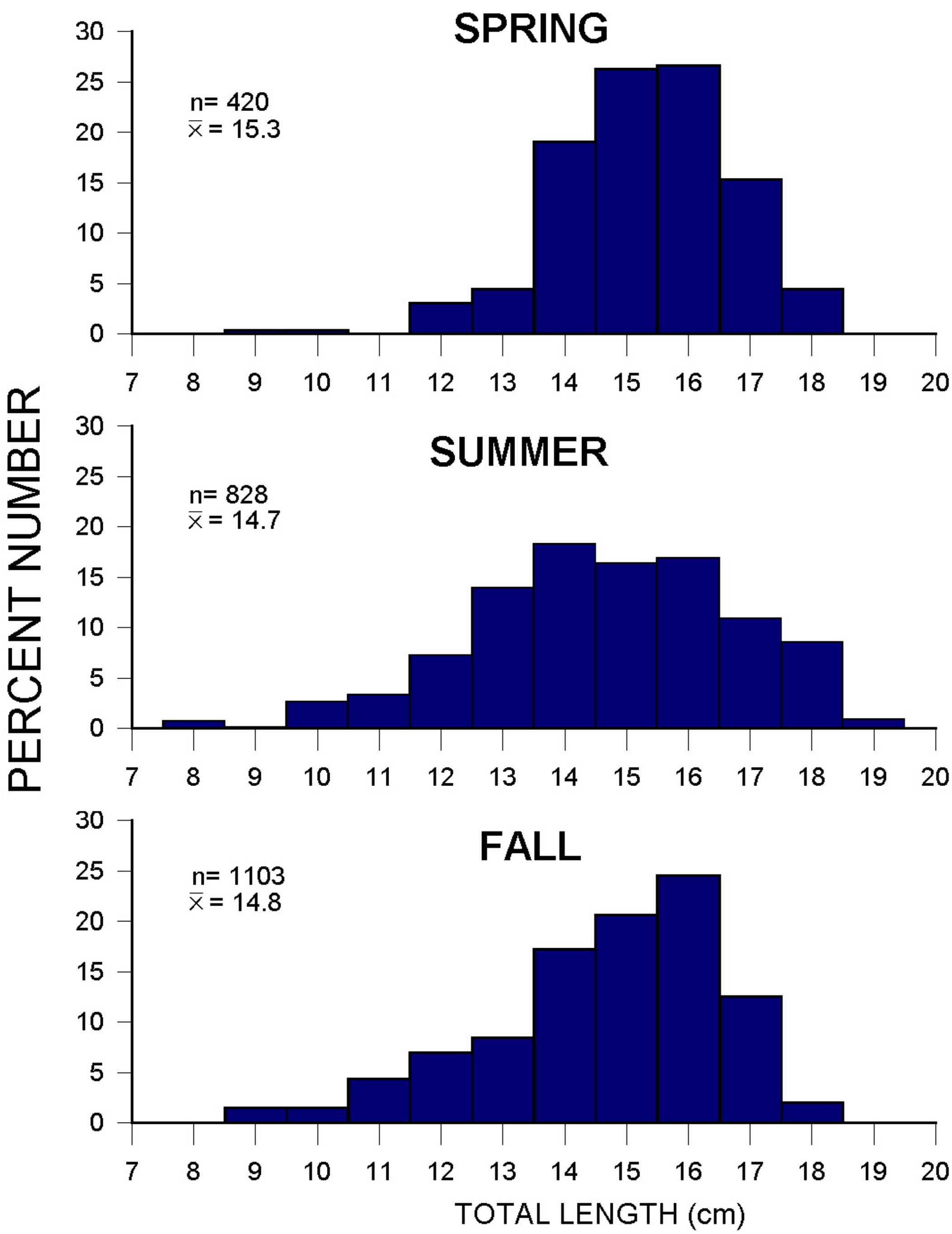

Figure 52. Seasonal length-frequencies of *Litopenaeus setiferus* in 2001.

L. setiferus inhabits estuaries until nearing maturity when they move offshore (Williams, 1984), where they are susceptible to capture by our gear. Regional mean lengths also differed significantly ($X^2 = 288$, $p < 0.0001$). Long Bay produced the smallest mean length (13.5 cm) and Georgia the greatest (15.3 cm) (Figure 53).

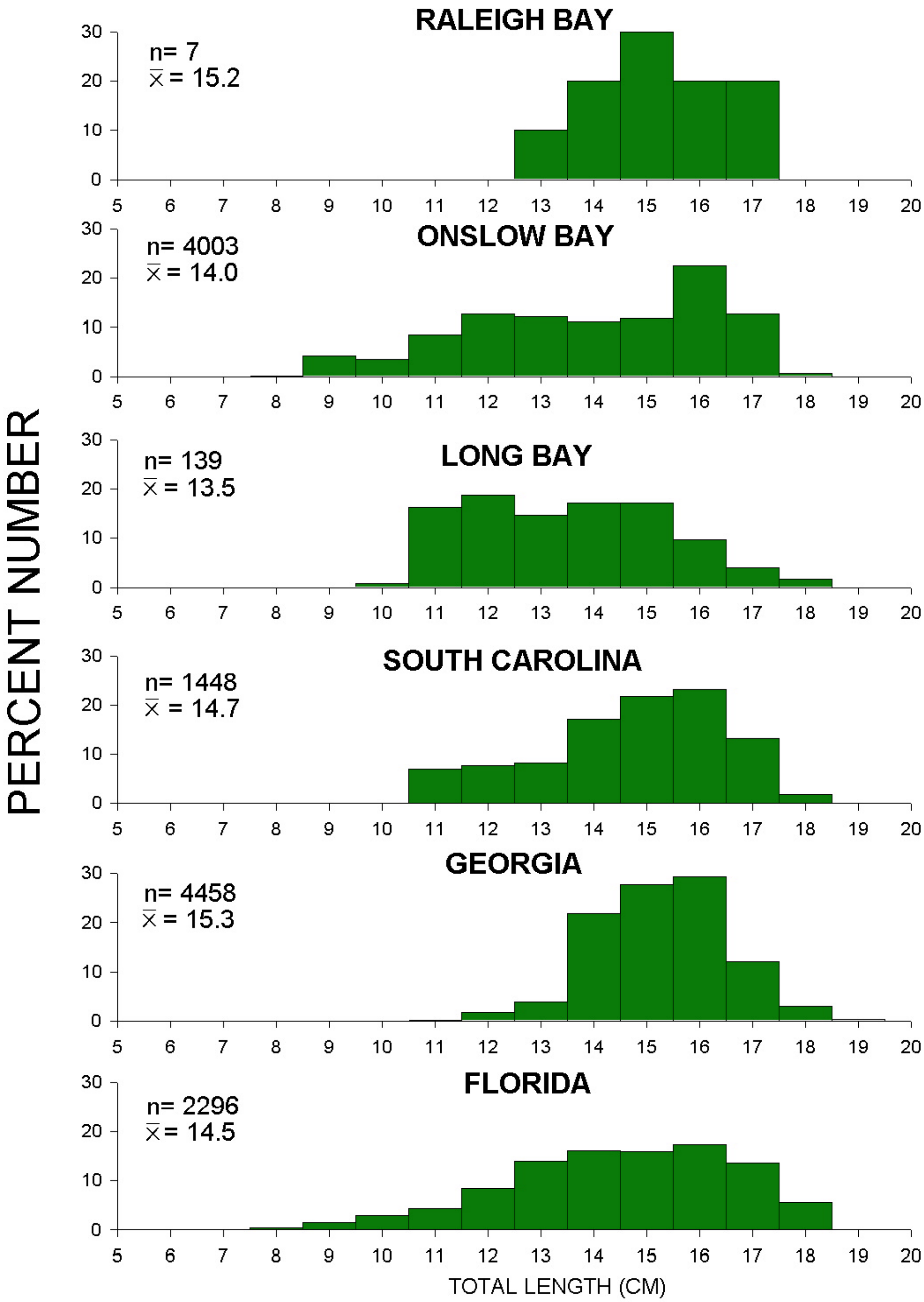

Figure 53. Regional length-frequencies of *Litopenaeus setiferus* in 2001.

White shrimp are reported to spawn from May through September in the SAB (Lindner and Anderson, 1956; Williams, 1984). The percentage of males with fully developed spermatophores peaked in summer, decreasing to 1% in fall, when the majority (84%) of the males taken were collected (Figure 54). The ratio of males with fully developed spermatophores to those with spermatophores not yet fully developed was not independent of seasons ($G = 2446$, $p < 0.0001$) or regions ($G = 913$, $p < 0.0001$). Only 1% of females collected in SEAMAP strata had ripe ovaries, and none of the white shrimp females collected were ripe in fall, when 92% of the females were taken. The ratio of ripe to nonripe females was not independent of season ($G = 4919$, $p < 0.0001$) or region ($G = 418$, $p < 0.0001$). The percentage of ripe females peaked in summer (61%). Less than 1% of the females taken in SEAMAP-SA trawls were mated.

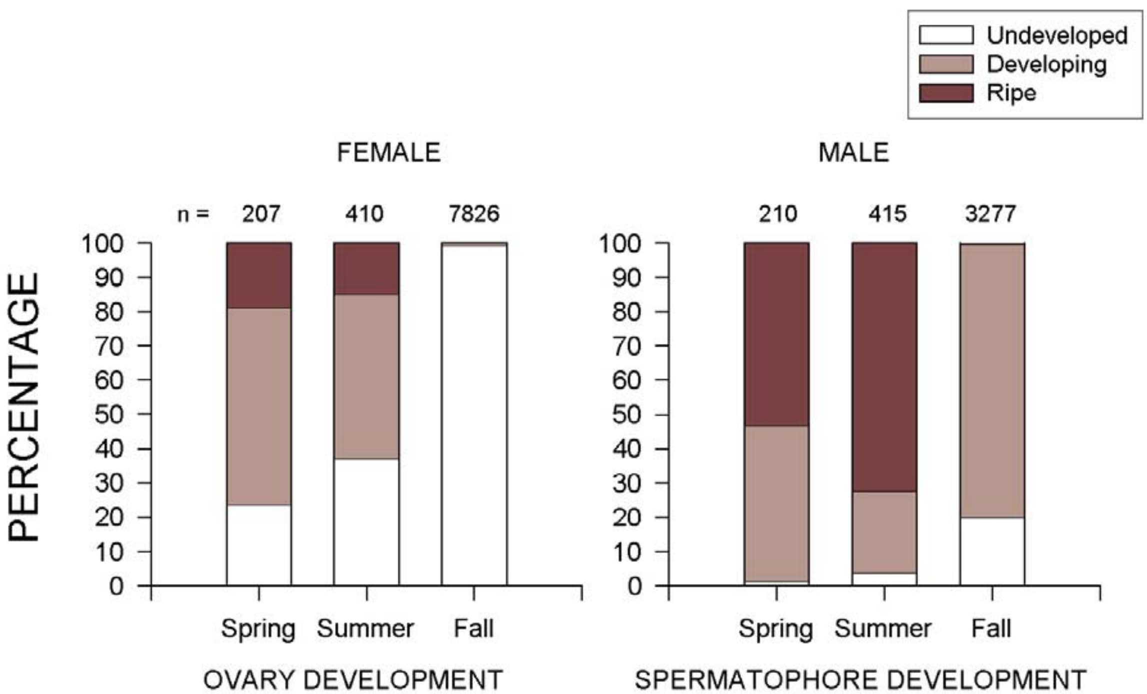

Figure 54. Gonadal development of *Litopenaeus setiferus* in 2001.

Distribution and Abundance of Coastal Sharks

In 2001 SEAMAP-SA collected thirteen species of sharks (Table 28), the greatest number of shark species collected in the South Atlantic Bight during the history of the survey. The overall abundance of sharks was also high, exceeded only in 1990. The Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, was the most abundant shark, making up approximately 43% of the shark specimens collected. The smooth dogfish, *Mustelus canis,* ranked second in abundance, followed by bonnethead shark, *Sphyrna tiburo.* The other ten species contributed less than 6% to the overall number of sharks collected.

Table 27. Coastal sharks collected in SEAMAP-SA trawls - 2001.

Rank	Common name	Species name	Number
1	Atlantic sharpnose	*Rhizoprionodon terraenovae*	864
2	Smooth dogfish	*Mustelus canis*	694
3	Bonnethead	*Sphyrna tiburo*	351
4	Sandbar	*Carcharhinus plumbeus*	28
5	Spiny dogfish	*Squalus acanthias*	21
6	Scalloped hammerhead	*Sphyrna lewini*	20
7	Blacknose shark	*Carcharhinus acronotus*	16
8	Spinner shark	*Carcharhinus brevipinna*	10
9	Sand tiger shark	*Odontaspis taurus*	7
10	Thresher shark	*Alopias vulpinus*	6
11	Nurse shark	*Ginglymostoma cirratum*	1
12	Blacktip shark	*Carcharhinus limbatus*	1
13	Atlantic angel shark	*Squatina dumerili*	1

Mustelus canis

The smooth dogfish, *Mustelus canis,* was the second most abundant shark species (n=694; CV=5.9) collected during the 2001 SEAMAP-SA survey. Densities of abundance were greatest since peak observed in 1990 (Figure 55). With the exception of a single individual taken in fall collections in Onslow Bay, this species was collected only in spring. Smooth dogfish were almost exclusive to the northern SAB. Only three individuals were taken south of Onslow Bay (Table 28).

Female *M. canis* outnumbered males (1.5 : 1.0). Typical of sharks in general (Hoenig and Gruber, 1990), females were significantly larger than males ($X^2 = 27.2$, $p < 0.0001$) . Total lengths of the smooth dogfish ranged from 53 to 122 cm for females ($\bar{x}$ = 73.5 cm, n = 413) and 54 to 113 cm for males ($\bar{x}$ = 68.4 cm, n = 281). Although mean length was greatest in Raleigh Bay for both males and females in spring, regional variations in total length of male *M. canis* were found to be significant ($X^2 = 22.3$, $p < 0.0001$), while those of females were not significant ($X^2 = 6.4$, $p > 0.05$).

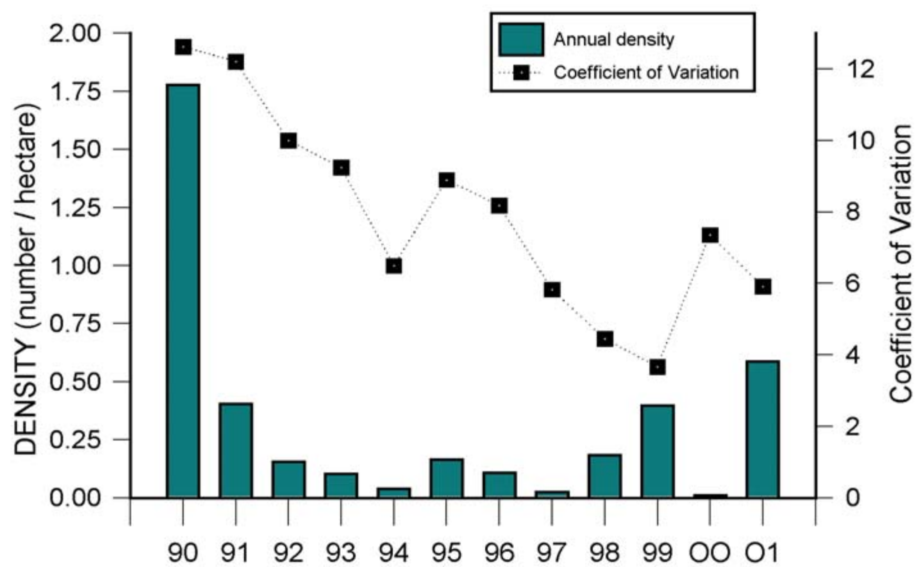

Figure 55. Annual densities of *Mustelus canis.*

Table 28 . Estimates of density (number of individuals/hectare) in 2001.

Mustelus canis

	Spring	Summer	Fall	Region
Raleigh Bay	15.0	0	0	5.2
Onslow Bay	2.1	0	0.01	0.7
Long Bay	0.02	0	0	0.007
South Carolina	0.03	0	0	0.01
Georgia	0	0	0	0
Florida	0	0	0	0
Season	1.7	0	0.03	0.6

Rhizoprionodon terraenovae

The Atlantic sharpnose shark was the most abundant shark species collected in 2001 (n=864; CV=1.7). The abundance of *R. terraenovae* has been consistent throughout the history of the survey, with a peak observed in 1997 (Figure 56). In 2001 Atlantic sharpnose were taken in all regions in all seasons. The highest densities of abundance were taken in summer and in the northern SAB (Table 29). Females ranged in size from 22 to 102 cm total length ($\bar{x}$ = 41.6 cm, n =357), whereas males ranged from 26 to 102 cm ($\bar{x}$= 51.3 cm, n =496). Lengths of both sexes differed significantly among seasons (females: X^2 = 33.5, p < 0.0001; males: X^2 = 145.1, p < 0.0001) and regions (females: X^2 = 7.0, p > 0.05; males: X^2 = 4.1, p > 0.05).

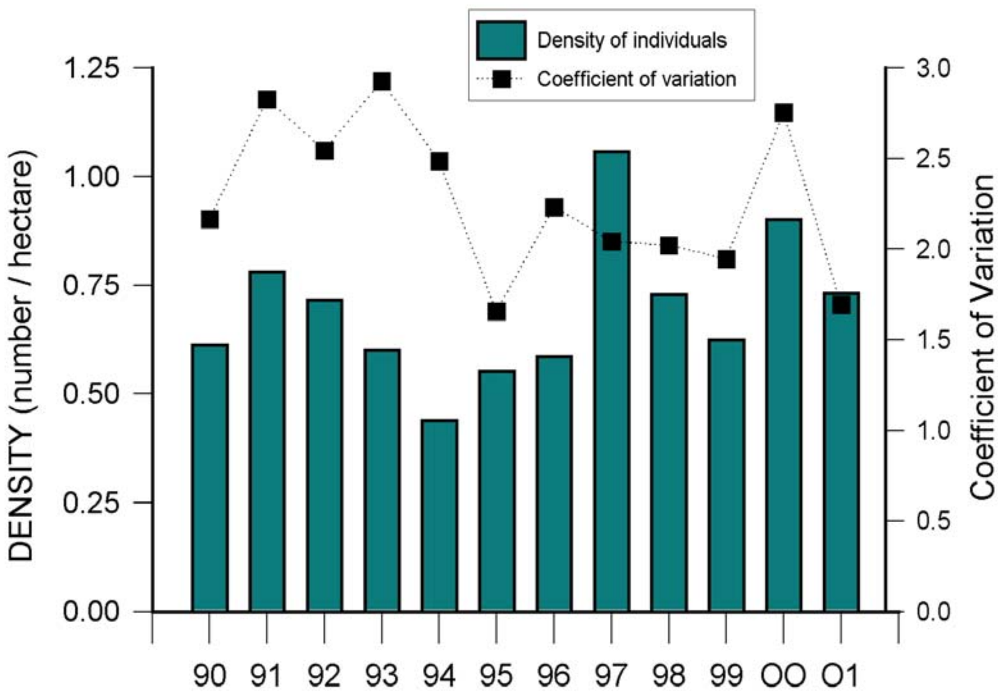

Figure 56. Annual densities of *Rhizoprionodon terraenovae*.

Table 29 . Estimates of density (number of individuals/hectare) in 2001.

Rhizoprionodon terraenovae

	Spring	Summer	Fall	Region
Raleigh Bay	0.2	2.8	0.04	1.0
Onslow Bay	0.8	2.5	0.3	1.2
Long Bay	1.2	1.9	0.4	1.2
South Carolina	0.3	1.6	0.06	0.6
Georgia	0.07	1.3	0.04	0.5
Florida	0.2	0.3	0.4	0.3
Season	0.4	1.6	0.2	0.7

Sphyrna tiburo

The bonnethead shark, *Sphyrna tiburo,* ranked third in abundance (n=351; CV=2.7) among sharks in 2001. Density of abundance second highest since peak in 1991 (Figure 57). Density was greatest in spring and summer (Table 30). Waters off Florida yielded the highest density in every season while no bonnethead sharks were taken in Raleigh Bay in any season.

Males outnumbered females (M:F 1.2:1). Although the mean length of female bonnetheads ($\bar{x}$ = 69.3 cm, n =152) was larger than that of males ($\bar{x}$ = 68.9 cm, n =182), the difference was not significant ($X^2 = 0.003$, $p > 0.05$). Total lengths of female *S. tiburo* ranged from 35 to 123 cm, whereas males ranged from 30 to 100 cm. Seasonal lengths differed significantly (males: X^2 = 12.5, $p < 0.005$; females: X^2 = 6.5, $p < 0.05$). Mean lengths of both sexes were greatest in summer and smallest in fall. Total lengths also varied significantly among regions (females: $X^2 = 13.8$, $p < 0.005$; males:($X^2 = 30.9$, $p < 0.0001$). Greatest mean length of males occurred in Long Bay and females off South Carolina. Smallest mean length of both species occurred off Florida.

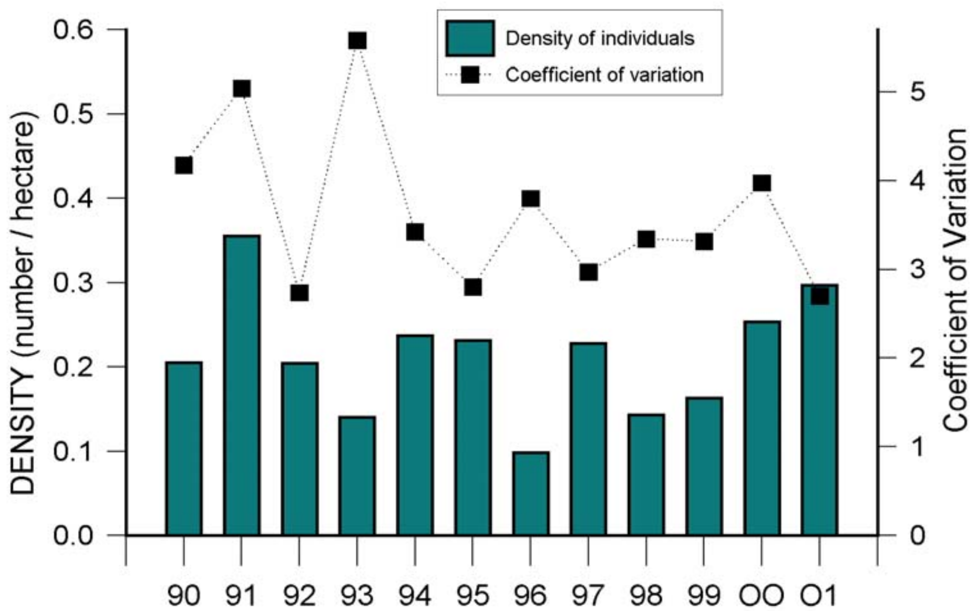

Figure 57. Annual densities of *Sphyrna tiburo.*

Table 30 . Estimates of density (number of individuals/hectare) in 2001.

Sphyrna tiburo

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0	0
Onslow Bay	0.01	0.08	0.01	0.04
Long Bay	0.4	0.3	0	0.3
South Carolina	0.1	0.2	0.02	0.1
Georgia	0.4	0.6	0.03	0.4
Florida	0.9	1.2	0.3	0.8
Season	0.3	0.5	0.07	0.3

Distribution and Abundance of Sea Turtles and Horseshoe Crabs

In 2001, sea turtles and horseshoe crabs became priority species for the SEAMAP-SA Shallow Water Trawl Survey. Although data have been taken on sea turtles since 1989 and on horseshoe crabs since 1995, those species have not been considered to be priority species.

In 2001, two species of sea turtle, the loggerhead, *Caretta caretta,* and the Kemp's ridley, *Lepidochelys kempi*, were taken in SEAMAP-SA trawls.

Caretta caretta

The loggerhead sea turtle is found in temperate and subtropical waters throughout most of the world, but will range far north and south and are found as far north as Newfoundland and as far south as Argentina in the Western hemisphere (Dodd, 1988). Loggerhead sea turtles prefer to feed in coastal bays and estuaries, as well as in the shallow water along the continental shelves of the Atlantic, Pacific and Indian Oceans.

The loggerhead turtle, *Caretta caretta*, is the most abundant sea turtle caught in SEAMAP trawls. In 2001 twenty two loggerhead (CV=3.7; 0.02 individuals/ha) were taken in SEAMAP trawls. Although the abundance of the loggerhead turtle has fluctuated annually, abundance has increased turtles had generally increased (Figure 58). In 2001 seasonal densities of abundance of *C. caretta* increased from spring to fall. Regionally, density was greater in the southern portion of the SAB. The majority of the loggerhead sea turtles taken in SEAMAP collections are considered to be sub-adults (Dodd, 1988).

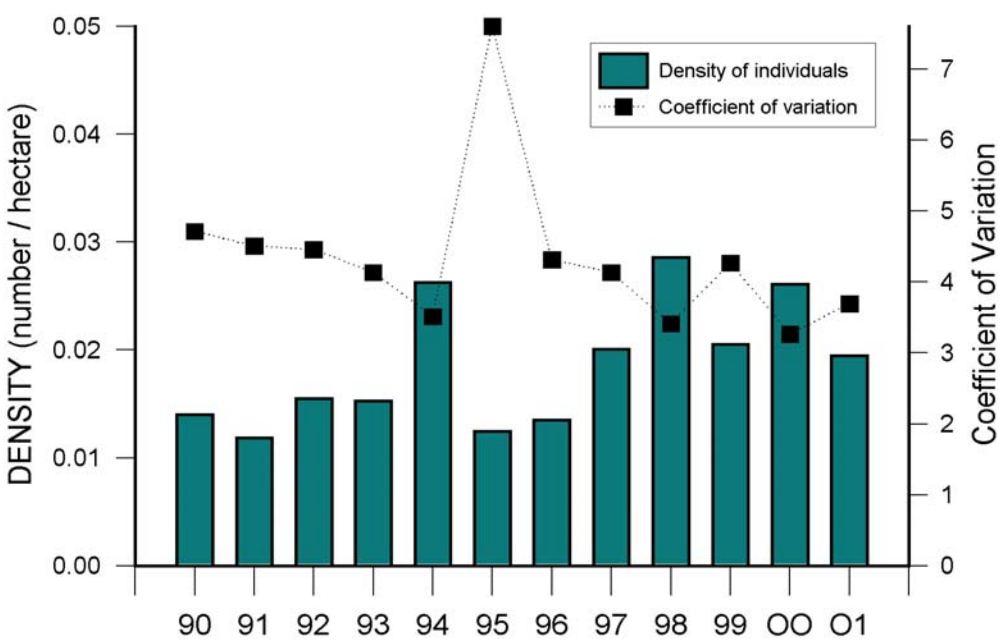

Figure 58. Annual densities of *Caretta caretta.*

Table 31 . Estimates of density (number of individuals/hectare) in 2001.

Caretta caretta

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0.04	0.01
Onslow Bay	0	0.01	0	0.005
Long Bay	0	0.02	0	0.007
South Carolina	0.03	0.04	0.02	0.03
Georgia	0.03	0	0.02	0.02
Florida	0.01	0.05	0.04	0.04
Season	0.01	0.02	0.03	0.02

Lepidochelys kempi

The Kemp's ridley turtle is the smallest of all marine turtles. Although *Lepidochelys kempi* is found in tropical and subtropical environments of the western north Atlantic, adults are almost exclusively restricted to the Gulf of Mexico (Marquez-M, 1994). The Kemp's Ridley Sea Turtle prefers shallow areas with sandy and muddy bottoms. Juveniles can be found up and down the east coast of the United States.

Densities of *L. kempi* peaked in 1999 (Figure 59). In 2001, only one Kemp's ridley turtle was taken in SEAMAP trawls. The single specimen occurred in fall collections in Long Bay.

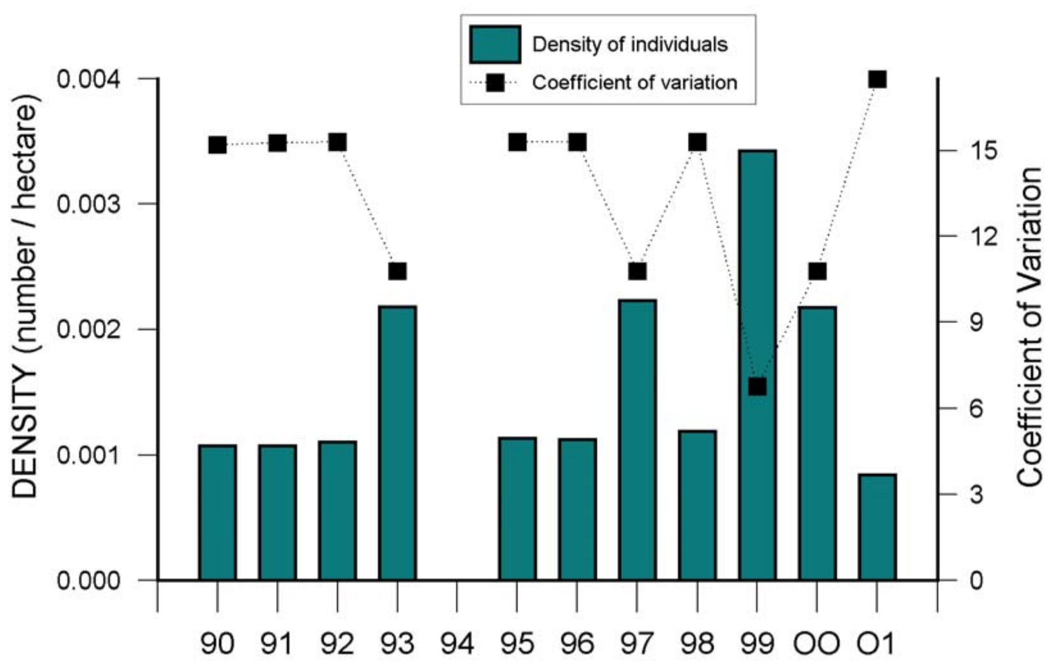

Figure 59. Annual densities of *Lepidochelys kempi*.

Limulus polyphemus

Along the Atlantic coast, horseshoe crabs are most abundant between Virginia and New Jersey with Delaware Bay at the center of the species distribution (Shuster, 1979). Horseshoe crabs range intermittently from the Yucatan peninsula to northern Maine. Each major estuary along the coast is believed to have a discrete horseshoe crab population that can be distinguished by adult size, carapace color, and eye pigmentation (Shuster, 1979). Along the Atlantic coast, horseshoe crabs are most abundant between Virginia and New Jersey with Delaware Bay at the center of the species distribution (Shuster and Botton, 1985).

A total of 45 horseshoe crabs (CV=3.6; 0.04 individuals/ha) were collected by the SEAMAP-SA Shallow Water Trawl Survey in 2001. Density of individuals for this species peaked in 1998 (Figure 60). In 2001, density of abundance was greatest in spring (Table 32). Horsehoe crabs were taken in all regions, except Long Bay. In the northern SAB, however, *Limulus polyphemus* were collected only in spring. Abundance was greatest in waters off Georgia.

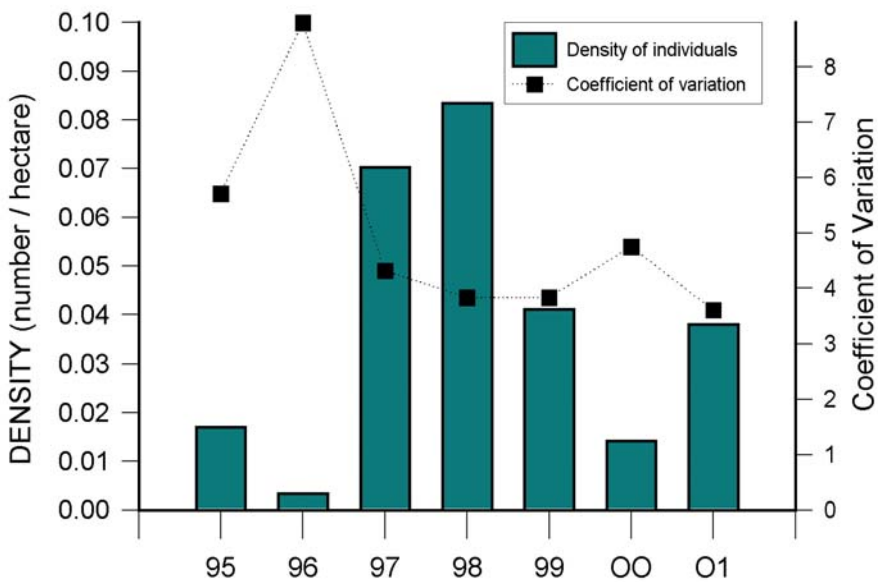

Figure 60. Annual densities of *Limulus polyphemus.*

Table 32. Estimates of density (number of individuals/hectare) in 2001.

Limulus polyphemus

	Spring	Summer	Fall	Region
Raleigh Bay	0.5	0	0	0.1
Onslow Bay	0.02	0	0	0.01
Long Bay	0	0	0	0
South Carolina	0	0.01	0.02	0.01
Georgia	0.1	0.01	0.1	0.08
Florida	0.01	0.03	0	0.01
Season	0.07	0.01	0.03	0.04

Distribution and Abundance of Cannonball Jellies

In 2001, the cannonball jelly, having been identified as a major component of overall biomass, was separated from other miscellaneous invertebrates and the abundance and biomass of *Stomolophus meleagris* was recorded for the first time by the SEAMAP - South Atlantic Shallow Water Trawl Survey.

The cannonball jelly was the most abundant species collected in SEAMAP-SA samples in 2001 and ranked first in biomass. The 83,368 individuals (CV=2.8), weighing 24,548 kg made up 16% of the total number of specimens taken in SEAMAP strata and 39% of the biomass. With the exception of Long Bay and South Carolina, seasonal densities of individuals were greatest in fall (Table 33). *Stomolophus meleagris* was taken in all regions. In Raleigh Bay, however, *S. meleagris* was collected only in fall and none were taken in summer trawls off Florida. Regional densities were highest off South Carolina and Georgia.

Table 33. Estimates of density (number of individuals/hectare) in 2001.

Stomolophus meleagris

	Spring	Summer	Fall	Region
Raleigh Bay	0	0	0.8	0.2
Onslow Bay	1.0	0.03	0.3	0.5
Long Bay	14.9	2.1	2.3	6.7
South Carolina	194.5	24.3	117.0	113.0
Georgia	53.0	32.8	408.5	164.0
Florida	1.8	0	101.2	33.3
Season	50.1	12.9	150.1	69.7

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APPLICATIONS OF SEAMAP SPECIMENS AND DATA in 2001

Stock Assessment/VPA:
Brevoortia tyrannus
Cynoscion regalis
Micropogonias undulatus
Paralichthys lethostigma

Life History (Age/Growth, Reproduction):
Diplectrum formosum
Haemulon aurolineatum
Menticirrhus americanus
Menticirrhus littoralis
Menticirrhus saxatilis

Genetics / Stock Identification Studies:
Cynoscion nothus
Larimus fasciatus
Leptogorgia sp.
Limulus polyphemus
Paralichthys lethostigma

Marine Forensic Standards:
Ginglymostoma cirratum

Taxonomy:
Diplectrum bivitatum

Educational/Graduate Student Research:
Limulus polyphemus blood samples for DNA analysis

Data requested by state agencies:
White shrimp gonadal development (2001) - SCDNR-Crustacean Management Section
Shrimp abundance summary (Spring 2001) - SCDNR-Crustacean Management Section
Shark abundance summary (1989-2001) - SCDNR
Sea turtle data (2001) - SCDNR / Office of Fisheries Management
2001 SEAMAP-SA data - NC Division of Marine Fisheries
2001 SEAMAP-SA data - NC DMF
2001 SEAMAP-SA data collected in Georgia waters - GADNR
Shrimp abundance summary (Spring 2001) - GADNR
Sea turtle data collected in Georgia waters(2001) - GADNR
2001 SEAMAP-SA data collected in Florida waters - Florida Fish and Wildlife Conservation Commission
Sea turtle data collected in Florida waters(2001) - FFWCC - Endangered Species Division

Data requested by other agencies:
Sea turtle data (2001) - NMFS Marine Turtle tagging database
Sea turtle data (2001) - CMTTP
Sea turtle data (1989-2000) - NOAA SEFSC
Shark data (2001) - NMFS, Narrangansett Lab
Shark data (2001) - NMFS, Highly Migratory Species, Silver Spring, MD

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Appendix 1. Size statistics of target finfish and decapod species from all SEAMAP-SA collections in 2001.

FINFISH	MEAN LENGTH/WIDTH (CM)	SIZE EXTREMES (CM)
Archosargus probatocephalus	49.1	40-56
Brevoortia smithi	24.5	21-27
Brevoortia tyrannus	14.3	8-27
Centropristis striata	15.5	10-31
Chaetodipterus faber	9.7	5-24
Cynoscion nebulosus	*	N/A
Cynoscion regalis	18.7	8-37
Leiostomus xanthurus	14.5	8-26
Menticirrhus americanus	21.5	9-37
Menticirrhus littoralis	25.2	14-38
Menticirrhus saxatilis	21.3	13-33
Micropogonias undulatus	16.9	3-27
Mycteroperca microlepis	*	N/A
Paralichthys albigutta	28.3	18-38
Paralichthys dentatus	23.3	12-48
Paralichthys lethostigma	28.8	18-42
Peprilus alepidotus	9.9	3-19
Peprilus triacanthus	9.2	2-18
Pogonias cromis	*	N/A
Pomatomus saltatrix	20.3	6-38
Sciaenops ocellatus	**	100
Scomberomorus cavalla	12.5	4-101
Scomberomorus maculatus	22.7	5-49
DECAPOD CRUSTACEANS		
Farfantepenaeus aztecus	12.8	8-19
Farfantepenaeus duorarum	11.9	7-18
Litopenaeus setiferus	14.7	8-19
Callinectes sapidus	13.6	7-18

* No specimens of *Cynoscion nebulosus, Mycteroperca microlepis,* or *Pogonias cromis* were collected.
** Only one specimen of *Sciaenops ocellatus* was taken.

Appendix 2. Number of individuals and biomass (kg) for all species collected in 2001.

Rank	Species Name	Total Number	Total Weight
1	*Stomolophus meleagris*	83368	24548.440
2	*Micropogonias undulatus*	72259	3451.483
3	*Leiostomus xanthurus*	54333	2485.126
4	*Stenotomus sp.*	45942	1498.085
5	*Peprilus triacanthus*	41269	1331.684
6	*Chloroscombrus chrysurus*	29682	363.139
7	*Cynoscion nothus*	15938	1611.340
8	*Libinia dubia*	14728	47.286
9	*Stellifer lanceolatus*	13620	224.375
10	*Litopenaeus setiferus*	12351	305.031
11	*Lagodon rhomboides*	11840	635.611
12	*Larimus fasciatus*	10569	822.273
13	*Anchoa hepsetus*	10277	78.880
14	*Farfantepenaeus aztecus*	10204	187.524
15	*Lolliguncula brevis*	9270	106.474
16	*Cynoscion regalis*	7366	401.421
17	*Selene setapinnis*	7289	74.092
18	*Loligo sp.*	7211	79.206
19	*Menticirrhus americanus*	7105	690.227
20	*Synodus foetens*	5186	352.877
21	*Anchoa mitchilli*	5019	7.768
22	*Peprilus alepidotus*	4342	203.702
23	*Ovalipes stephensoni*	3425	22.560
24	*Opisthonema oglinum*	3412	112.652
25	*Trichiurus lepturus*	3093	248.439
26	*Orthopristis chrysoptera*	2676	187.812
27	*Portunus gibbesii*	2359	22.099
28	*Scomberomorus maculatus*	2324	251.527
29	*Bairdiella chrysoura*	1887	68.250
30	*Anchoa lyolepis*	1549	1.710
31	*Urophycis regius*	1374	34.198

Rank	Species Name	Total Number	Total Weight
32	*Pomatomus saltatrix*	1257	133.825
33	*Prionotus carolinus*	1150	19.062
34	*Brevoortia tyrannus*	1023	49.278
35	*Callinectes similis*	914	13.326
36	*Trinectes maculatus*	892	31.577
37	*Rhizoprionodon terraenovae*	864	564.927
38	*Mustelus canis*	694	861.256
39	*Scophthalmus aquosus*	673	17.775
40	*Caranx crysos*	663	40.418
41	*Farfantepenaeus duorarum*	593	9.408
42	*Selene vomer*	567	11.909
43	*Rhinoptera bonasus*	552	2780.968
44	*Scomberomorus cavalla*	482	22.255
45	*Eucinostomus sp.*	435	6.146
46	*Raja eglanteria*	433	348.653
47	*Squilla empusa*	429	7.713
48	*Dasyatis sayi*	415	497.358
49	*Paralichthys dentatus*	413	58.251
50	*Citharichthys macrops*	352	6.152
51	*Sphyrna tiburo*	351	607.665
52	*Sphyraena guachancho*	340	10.811
53	*Myliobatis freminvillei*	332	1696.129
54	*Etropus crossotus*	310	6.967
55	*Prionotus scitulus*	305	6.670
56	*Symphurus plagiusa*	297	10.041
57	*Callinectes sapidus*	291	42.078
58	*Chaetodipterus faber*	273	12.503
59	*Prionotus evolans*	225	7.012
60	*Sphoeroides maculatus*	216	18.398
61	*Gymnura micrura*	209	178.412
62	*Portunus spinimanus*	209	3.626
63	*Squilla neglecta*	206	2.490
64	*Menticirrhus littoralis*	179	28.880
65	*Ovalipes ocellatus*	176	3.500
66	*Trachinotus carolinus*	174	27.544
67	*Centropristis philadelphica*	172	5.236
68	*Arenaeus cribrarius*	171	3.542

Rank	Species Name	Total Number	Total Weight
69	*Ancylopsetta quadrocellata*	161	6.908
70	*Chilomycterus schoepfi*	144	38.374
71	*Decapterus punctatus*	137	8.665
72	*Harengula jaguana*	135	2.800
73	*Xiphopenaeus kroyeri*	128	1.261
74	*Menticirrhus saxatilis*	103	10.701
75	*Libinia emarginata*	81	1.638
76	*Etropus cyclosquamus*	76	0.914
77	*Paralichthys lethostigma*	73	21.105
78	*Centropristis striata*	66	3.985
79	*Sardinella aurita*	53	0.195
80	*Persephona mediterranea*	52	0.416
81	*Prionotus tribulus*	50	1.443
82	*Limulus polyphemus*	45	100.158
83	*Arius felis*	44	6.687
84	*Echeneis naucrates*	44	7.093
85	*Trachurus lathami*	44	0.594
86	*Monacanthus hispidus*	37	0.424
87	*Citharichthys spilopterus*	34	0.356
88	*Syacium papillosum*	33	1.593
89	*Mobula hypostoma*	32	440.060
90	*Pagurus pollicaris*	32	0.786
91	*Rimapenaeus constrictus*	31	0.117
92	*Carcharhinus plumbeus*	28	63.200
93	*Hepatus epheliticus*	25	0.463
94	*Callinectes ornatus*	24	0.284
95	*Dasyatis sabina*	23	5.524
96	*Paralichthys albigutta*	23	6.299
97	*Caretta caretta*	23	1082.250
98	*Squalus acanthias*	21	31.378
99	*Dasyatis americana*	21	59.291
100	*Haemulon aurolineatum*	21	0.585
101	*Sphyrna lewini*	20	31.600
102	*Urophycis floridanus*	18	1.041
103	*Loligo pealei*	18	0.214
104	*Menippe mercenaria*	17	0.994
105	*Carcharhinus acronotus*	16	193.203

Rank	Species Name	Total Number	Total Weight
106	*Aluterus schoepfi*	15	2.451
107	*Gymnura altavela*	13	259.180
108	*Alectis ciliarius*	12	0.157
109	*Dasyatis centroura*	11	388.690
110	*Bagre marinus*	11	3.719
111	*Archosargus probatocephalus*	11	33.370
112	*Prionotus salmonicolor*	11	0.193
113	*Caranx hippos*	10	0.968
114	*Carcharhinus brevipinna*	10	83.362
115	*Odontaspis taurus*	7	362.620
116	*Aetobatus narinari*	7	170.170
117	*Lutjanus synagris*	7	0.092
118	*Diplectrum formosum*	6	0.168
119	*Calamus leucosteus*	6	5.167
120	*Alopias vulpinus*	6	165.010
121	*Diplectrum bivittatum*	6	0.154
122	*Sicyonia brevirostris*	6	0.038
123	*Cancer irroratus*	6	0.040
124	*Rachycentron canadum*	5	0.378
125	*Seriola dumerili*	5	1.327
126	*Seriola zonata*	5	1.330
127	*Lysmata wurdemanni*	5	0.009
128	*Pilumnus sayi*	5	0.084
129	*Neopanope sayi*	5	0.008
130	*Brevoortia smithi*	4	1.007
131	*Elops saurus*	3	0.471
132	*Opsanus tau*	3	0.133
133	*Urophycis earlli*	3	0.205
134	*Hippocampus erectus*	3	0.019
135	*Diplodus holbrooki*	3	0.052
136	*Chaetodon ocellatus*	3	0.049
137	*Lagocephalus laevigatus*	3	0.073
138	*Upeneus parvus*	3	0.039
139	*Eurypanopeus depressus*	3	0.003
140	*Narcine brasiliensis*	2	1.340
141	*Ophichthus gomesi*	2	0.500
142	*Mugil curema*	2	0.065

Rank	Species Name	Total Number	Total Weight
143	*Astroscopus y-graecum*	2	0.237
144	*Hypsoblennius hentzi*	2	0.010
145	*Priacanthus cruentatus*	2	0.020
146	*Hyporhampus meeki*	2	0.034
147	*Calappa flammea*	2	0.375
148	*Portunus sayi*	2	0.018
149	*Octopus vulgaris*	2	0.599
150	*Ginglymostoma cirratum*	1	15.840
151	*Carcharhinus limbatus*	1	1.761
152	*Squatina dumeril*	1	14.070
153	*Rhinobatos lentiginosus*	1	0.004
154	*Acipenser oxyrhynchus*	1	25.000
155	*Ophichthus ocellatus*	1	0.250
156	*Alosa aestivalis*	1	0.101
157	*Histrio histrio*	1	0.010
158	*Ogcocephalus parvus*	1	0.492
159	*Syngnathus floridae*	1	0.010
160	*Syngnathus louisianae*	1	0.011
161	*Syngnathus springeri*	1	0.010
162	*Oligoplites saurus*	1	0.064
163	*Selar crumenophthalmus*	1	0.039
164	*Lutjanus analis*	1	0.093
165	*Eucinostomus harengulus*	1	0.008
166	*Sciaenops ocellata*	1	11.070
167	*Astroscopus guttatus*	1	0.005
168	*Hypleurochilus geminatus*	1	0.002
169	*Gobiosoma bosci*	1	0.001
170	*Prionotus ophryas*	1	0.010
171	*Gymnachirus melas*	1	0.020
172	*Acanthostracion quadricornis*	1	0.550
173	*Lepidochelys kempi*	1	18.000
174	*Alpheus formosus*	1	0.012
175	*Petrochirus diogenes*	1	0.012
176	*Pagurus longicarpus*	1	0.002
177	*Albunea paretii*	1	0.006
178	*Hexapanopeus angustifrons*	1	0.004